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NEWS ITEMS FROM NICARAGUA, sent us by a correspondent under date July 13, are the following: There had been six ocean steamers at Greytown to discharge cargo in the previous week. Mr. C. P. TREAT, contractor for the railway across the flats to the great divide cut, is pushing his work, and the facilities for discharging are to be improved. There is plenty of rain and water in the San Juan River, but the boats and service are far from being what they should be. Mr. TREAT has returned to this country, his work being far advanced, so that a few weeks will see it completed.

About three miles of track has now been laid, which includes all the expensive and troublesome part of the work. The remaining seven miles for which Mr. TREAT has the contract will be rapidly finished, certainly by Nov. 1, about 500 men being at work on it, and the total cost of this ten miles is not likely to exceed $20,000 per mile, including track. About seven miles more will then be required to carry the track over the great divide cut, which is all comparatively easy work, being above the coast swamps.

THE TOTAL MILEAGE OF STREET RAILWAYS to date in the United States and Canada is given as follows by the *Street Railway Journal*:

Miles of horse railway	5,902½
" electric	1,753
" dummy	556
" cable	441
Total mileage	8,652½
Number of electric roads	264
" cable "	44

A TRANS-SAHARA RAILWAY across the great desert is proposed by French interests. It so happens that the most favorable route, as respects wind storms and oases, is the shortest. Starting at a distance of some 280 miles from the Mediterranean, some 1,250 miles of railway only would be required. A concession of $1,200,000 per annum, or about $1,000 per mile, is deemed sufficient to ensure construction, the existing Algerian railways, aggregating some 1,700 miles, burdening the Algerian budget with $4,800,000 per year. The cost of building such a road would, of course, be small.

REDUCED FARES TO EMPLOYEES and their families have been granted by the London & Northwestern Ry. Co. in response to numerous petitions. Employees and their wives may travel at times when passes cannot be granted on payment of ½ of the ordinary fare and children under 12 at ⅓ the ordinary fare. Over 40,000 persons are affected by this order.

THE SOUTHEASTERN RY. (England) is reported as running about 800 trains per 24 hours in and out of the Cannon street station, London. Steps will be taken at the next session of Parliament to obtain authority for the construction of lines to connect with the northern railway systems, so as to facilitate through traffic. Improvements of an extensive character are contemplated for the London Bridge station. The third class passenger traffic is rapidly growing. For the last half year both the first and second class showed a falling off of several thousand passengers, but the third class traffic increased by 855,368 passengers, the receipts from whom were $147,620.

THE CONNECTICUT GRADE CROSSING LAW provides that every railway company shall remove at least one grade crossing per annum for each 60 miles of road operated in the State. The New York, New Haven & Hartford is the only company which has obeyed the law, and the Railroad Commissioners have sent notices to the New York & New England, the Central New England & Western and the Housatonic, which are the only roads beside the New York, New Haven & Hartford operating more than 60 miles of road in the State, calling their attention to their neglect to comply with the law.

RAILS WEIGHING 200 LBS. PER YD. ARE CONTEMPLATED by the Metropolitan (underground) Ry. of London. They will be of the bulb-head section, of course. Like other English railways the Metropolitan finds its third class traffic enormously increasing, while its third-class is of insignificant proportions. In the past year there was an increase of 21,900 first-class passengers, 62,400 second-class and 584,000 third-class. The latter were carried at an average cost of 1¼ cents. The managers think the use of one class of carriages only with a separate compartment for the aristocracy will soon become advisable.

STEEL CROSS-TIES have been laid on three-fourths of a mile of the Delaware & Hudson Co.'s track near Saratoga Springs, N.Y., by the Standard Metal Tie and Construction Co. They weigh 90 lbs. each, and were laid about 2.6 ft. apart, the rails being supported on creosoted blocks placed in a recess in the tie. A parallel track has been laid with new Georgia pine ties, in order to compare the two systems when subjected to equal wear.

PERMISSION TO ESTABLISH A CABLE RAILWAY ON BROADWAY, NEW YORK, has been granted by the State Railroad Commission. The company is to repave and keep in repair the space between its tracks and for 2 ft. each side. Grooved rails must be used as soon as possible, but permission is granted to lay tram rails temporarily, until the grooved rails can be obtained.

THE CENTRAL LONDON (ELECTRIC) RY., bill has been thrown out, as involving a great work of too experimental a character. It was proposed to construct a tunnel under Oxford street, the great east and west artery of traffic, and to operate the line by electricity from one or more central stations. It was pointed out by the opposition, however, that no connections could be made for through traffic with the existing underground systems, and that the experimenting with electrical traction would be difficult to carry on in a tunnel, would be on too large a scale, and might lead to great inconvenience of traffic. It was shown that the electric railway, as distinct from the electric tramway, was in a very preliminary stage as yet, not warranting its application to so important a line. Nearly every year there are schemes for surface or underground lines along this thoroughfare, cutting across the area enclosed by the existing underground railways. Pneumatic, electric and steam railways, and steam car lines have been projected, but all without success. The underground schemes generally include claims for a much better ventilation, and consequently a more pleasant and healthy line, than that of the present underground lines.

THE WORST ACCIDENT of the week was, as usual, a collision. On the Ontario, Carbondale & Scranton division of the New York, Ontario & Western, July 31, a gravel train collided with a coal train running in the opposite direction, and four Italian laborers were killed outright.—A wreck which was much more widely reported than the above was a head collision which occurred Aug. 3, near Salt Creek, Ind., between two passenger trains on the Louisville, New Albany & Chicago, killing two men and injuring a dozen. Still another collision occurred on the same road this week, smashing a new engine and 11 freight cars, but fortunately injuring no one. This road has had a continual series of collisions for the past few weeks, most of them very serious ones. If statistics were obtainable, it is pretty certain that the loss from the past two months' collisions on this road would pay for equipping the whole line with the block system.—Another very serious collision occurred on the St. Louis & Hannibal, Aug. 2, killing three men and injuring several. A switch engine ran into the rear of a crowded passenger coach.—Among other bad collisions are two on the Delaware & Hudson, one on the Newport News & Mississippi Valley and one on the Illinois Central.

A BRIDGE ACCIDENT OCCURRED at Grafton, W. Va., on Aug. 3. One car of a freight train on the Baltimore & Ohio jumped the track and knocked down a span of the bridge over the Tygart's Valley river. One brakeman and eight loaded cars went down with the wreck.—Part of the approach to the James St. viaduct in Kansas City fell on July 29, killing one man and injuring another. The coroner's jury found the accident to be due to faulty construction.—A local freight on the Cincinnati & Muskingum Valley went through a trestle at McCrea Park, July 31.—At Honeyoe Falls, N. Y., Aug. 1, a highway bridge fell under a traction engine.—At Osaksoosa, Ia., July 31, a bridge gave way under a steam thresher.

A BAD WASHOUT on the Atlantic & Pacific occurred Aug. 6. A bridge 2 miles west of Yucca, Ariz., was washed out, and a train fell into the gap. Severe storms have occurred all along the line in Arizona. Another washout occurred at Milford, Utah, recently, making a bad wreck. Two serious train accidents have been due to boulders on the track; one on the Chicago, Burlington & Northern, near Diamond Bluff, Wis.; and the other on the Cincinnati Southern, near Oakdale Junction, Tenn., killing the engineer and fireman of the wrecked train.

THE NEW DIAMOND SHOALS LIGHTHOUSE contract, the publication of the competitive plans for which we complete this week, has been awarded to Anderson & Barr for the amount of their bid, $485,000, as has been generally expected would be the case, the bids not being far enough apart in amount to make the difference in that respect a serious consideration, while they offered to build a much more massive foundation than either of the other bidders, have built the only other structure on our coast which is at all comparable with the one proposed, and have a record in difficult foundation work which, without prejudice to either of the other very competent bidders, may be said to be quite unequaled. It may be claimed, and perhaps with truth, that either of the other structures was sufficiently deep and massive for the requirements, but no man can predict the precise requirements of such a locality, and the Board doubtless held that this is no structure to take chances on. Borings must now be made by Messrs. Anderson & Barr to determine the precise location of the structure, which, within a considerable area, is left to their own choice.

THE LEARY RAFT has reached New York after a voyage of 50 days from St. John, N. B. It is built in 14 sections, each section being 60 ft. long, 36 ft. wide and containing 500 logs. Iron chains bind the logs together and connect the sections. The voyage was somewhat rough; near Machias Island, Me., 2 sections were lost in a storm and another broke away near Portland. There are 8,000 tons of Norway pine spruce and hackmatack in the raft, and the saving of custom duties by bringing the timber into the country in the rough is about $5,000. The value of the raft is $40,000. Most of the timber will be used in the Harlem River improvements for which Mr. LEARY is contractor.

The Barnes Feed Water Heater and Purifier.

By courtesy of Mr. J. B. BARNES, Superintendent of Motive Power and Machinery of the Wabash Railroad, we are enabled to present herewith drawings of a novel device to facilitate the successful use of bad water in boilers, which strikes us as highly meritorious; in fact, as one of the most promising improvements of the evaporative features of the locomotive boiler which have been made in a long time. If it retains its present promise it ought to be of especial value throughout our western country, where the water is more often bad than good. Furthermore, on the same principle that all whiskey is declared to be good, some being better than others only, all water fed in practice to locomotive boilers may be declared to be bad, there being only degrees of badness; and this device is so simple and inexpensive, and provides so much better a mode of supplying feed water, and getting rid of precipitated impurities, apart from its effect in extracting those impurities, that it may prove worthy of very general use even where the feed water is fairly good.

The general nature of the device is that the barrel has an interior sheet (Figs. 1, 2, 3, 4), which is divided by a partition *a*, Fig. 1, into two unequal parts. In the forward part, which is an hermetically sealed space except for an opening in the bottom of the partition *a*, the check valve admits the feed water. In the larger rear space the water enters below and then very slowly rises, being heated meantime to the boiling point, and flows over a long slit above the water line close to the outer shell, nearly all its impurities being naturally left behind; these impurities settle around a long clear space formed by the angle iron *b*, Figs. 1 and 2, perforated with semicircular holes of 1 in. diameter and 8 ins. apart between centers, and are then blown off from time to time through a special blow-off cock (Fig. 5), which draws only from this interior space, shown in plan in Fig. 2, and thus cleans equally well the whole length of the barrel.

What impurities still remain in the water will naturally settle chiefly in the lower part of the fire-box, and these are taken care of as shown in Figs. 6, 7, 8, a thin perforated plate being carried around just above the mud-ring. From the limited space below this plate, consequently, and not from the interior generally, the blow-off cock will draw its supply. Furthermore, when impurities are allowed to settle on the mud-ring, the current touches them only in the immediate vicinity of the blow-off cock, while, if they settle on the perforated plate, as they naturally will do when it is there to receive them, the blowing off from the comparatively limited space below the plate causes a violent downward current through all the perforations which tends to carry with it not only all impurities above the plate, but also to thoroughly cleanse the space below, all around the fire-box. The form of blow-off cock used is shown in Fig. 9.

Further details of the device, and the results of experience with it, we cannot give better than b quoting the substance of the letter from Mr. BARNES, of date July 3, 1890, which accompanied the plans herewith engraved, changing only the references to blue prints to make them correspond with the numbers of our engravings.

You will notice that the device consists of an intermediate sheet inside of the barrel of boiler and riveted to the shell of boiler at each end through solid rings 2¾ × 1¼ ins. (Fig. 1 and 3), closed by a longitudinal rib *c* at the top, making the space between the shell and this sheet water-tight, with the exception that in the third ring which is riveted 26 to 30 ins. back from the front ring there is an opening or gap of 12 ins. at bottom.

Back of the rib *a*, this sheet extends around and upward with the boiler shell, 2¾ ins. distant therefrom, to within 7 to 9 or more inches above the top of crown sheet, where it is flanged inward to within ¾ in. of the shell. The front end of this sheet, in front of *a*, is dropped 6 ins. or more to clear the flue sheet braces and side seam of boiler. Between the front ring and the ring *a* the sheet is riveted water-tight to the shell at the top, as stated. The water entering through the check valve is therefore compelled to pass downward and through the opening in the ring *a*, and then rise to the top of the main sheet before it can enter into the boiler proper, or touch the flues.

In the meantime, of course, the water has come to a high boiling heat, and the solids and foreign matter are precipitated to the bottom in the annular space outside of the inner shell. You will notice that the inside sheet rests at the bottom on angle iron, represented along the bottom of Fig. 1 and shown in plan in Fig. 2. This angle iron has segmental perforations or openings, as shown in Fig. 1.

You will notice the sheet is braced in the center, at the top, and on each side, by a short stay, shown in dotted lines in Fig. 1.

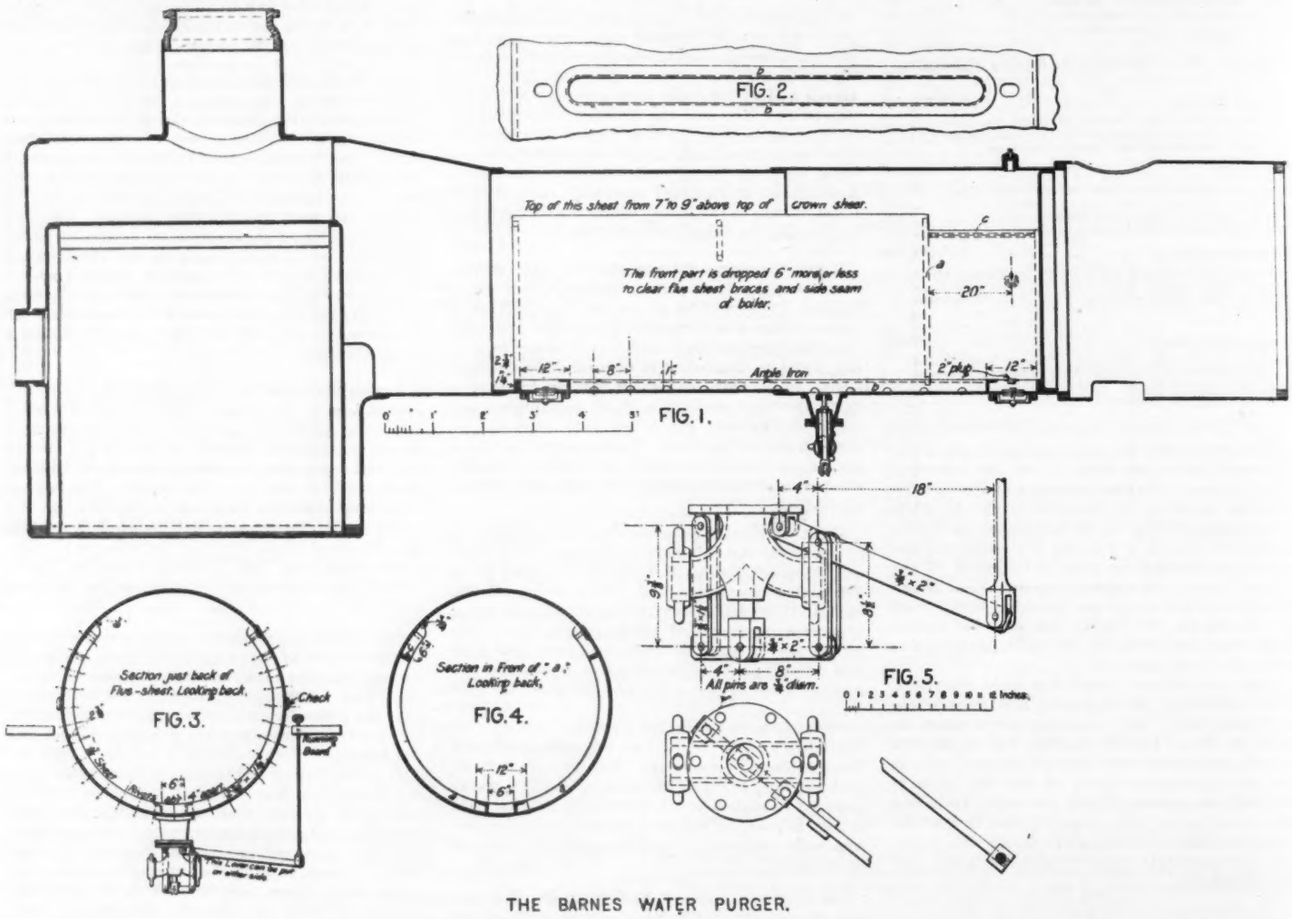
It is a well known fact that water at a high boiling heat purifies itself of most of its impurities, and our experience so far proves that nothing except the very lightest of the foreign matter floats over the top of this sheet.

A valve of my design is placed under the belly of the boiler, as shown in Figs. 1 and 3 and in detail in Fig. 5, which is operated by levers extending above the running board. With this valve opened, and a slight pressure in the boiler, the steam rushes with terrific force down each side of the interior annular sheet, carrying with it all foreign matter, and thoroughly cleansing the portion of boiler between the outer shell and the inner sheet. It is, therefore, a perfect "skimmer," and it matters not in what class of water the engine operates, there can never be any trouble from foaming.

We do not pretend to change the water from first filling, after giving the engine a new fire-box and new flues. The simple opening of this valve for a few seconds after the first 50 miles or so of run thoroughly removes all the grease, dirt, and other foreign matter which acts on the water to make it foam. You will notice also that even if this valve is left wide open, and even with a heavy fire in the furnace, there is no danger whatever of damaging any part of the boiler or fire-box by burning, as the boiler remains full of purified water several inches above the crown sheet.

Hand-hole plates are placed on the belly of the boiler, under each end of the inside sheet, for the purpose of making examinations, or, if found necessary, for washing out with pressure from the pumps. A 2-in. plug is placed through the inside sheet immediately above the front hand-hole plate, simply for purpose of examining the condition of the flues in front end.

In the fire-box leg I place a perforated sheet, which rests upon the lower row of stay bolts immediately above the mud-ring, as shown in Figs. 6, 7 and 8. A valve of special design is then placed between this sheet and the mud-ring, which when open causes the water to rush with terrific force down through the perforations, thoroughly washing and cleansing the space above the mud-ring of



THE BARNES WATER PURGER.

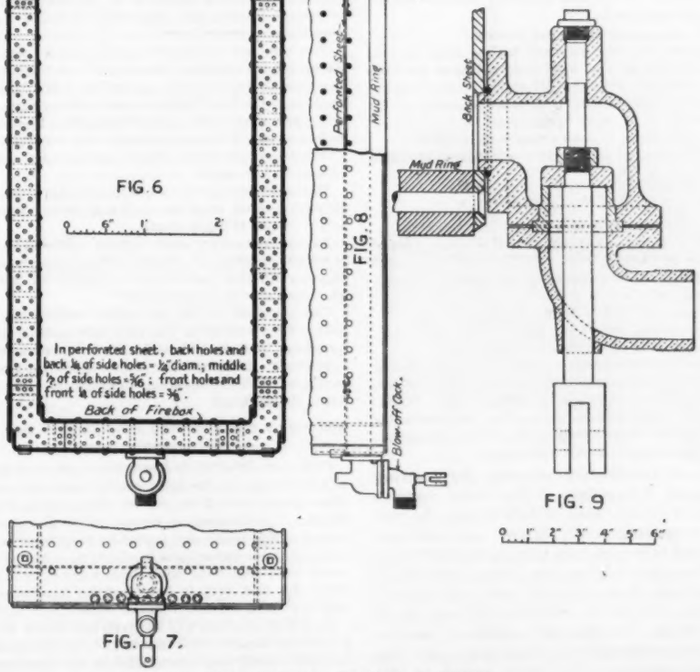
foreign matters which may possibly have entered the boiler over the sheet in the barrel.

You will observe that the placing of this sheet in the barrel of the boiler not only adds strength thereto, but prolongs the life of the boiler, as it is impossible for mud or scale accumulations to form, adhere to the tubes and base, as is the case in ordinary engines, where there is water of any impurity whatever. Hence, with this device, much better evaporation is obtained on account of it being a perfect water circulator; and when engines are working to their extreme limit the steaming quality is not affected even with both injectors or pumps working.

The device results in a saving of at least $50 per month on each engine in fuel and expense of washing out alone, not taking into consideration that you have more nearly continuous use of the engine, and that the life of the flues, boiler, and fire-box is lengthened beyond calculation. The possibility of damage to engines from washing out before they are properly cooled off, which is often unavoidable, is also done away with.

We have a number of engines now running which have made 10,000 miles without being washed out, and they carry their water as clear as crystal. They have been in service since February last. When old scale and mud is not thoroughly removed from engines while in shop for repairs we find the action of the purified water is to loosen and dissolve this matter; and it is expelled through the valves above mentioned.

I believe we can run engines safely without washing


Front of Firebox
FIG. 6
0 6" 1' 2'
In perforated sheet, back holes and back ½ of side holes = ½" diam.; middle ½ of side holes = 5/16"; front holes and front ½ of side holes = 3/8".
Back of Firebox
Perforated Sheet
Mud Ring
FIG. 8
Blow-off Cock.
Back Sheet
Mud Ring
FIG. 9
0 1' 2' 3' 4' 5' 6'
FIG. 7.

THE BARNES BOILER CLEANER.

once in a twelvemonth in such water as we find through the States in which the Wabash road operates; in fact, I believe it can be done in any water throughout the western country.

The claims here made do not seem to us at all exaggerated. Experience alone, of course, is the final criterion for devices of this kind. Difficulties may develop which are not yet thought of. But it is not easy to see where such can arise, while it certainly would seem as if the device afforded a more philosophical and effective way of feeding the boilers, and occasionally cleaning them, even if the feed water were of the best quality; and so was almost worth using in itself apart from special badness of water. We should confidently expect to see a boiler of this kind show a better evaporation than one of the ordinary type, even with good water, especially after months of service. It will be observed that the outer shell can be entirely emptied of water, so that nothing but steam blows out, without lowering the water around the heating surfaces; the only difference being that a large amount of water would have to be pumped in before the interior water supply could be replenished. We are not advising the experiment, but merely noting its possibility.

We have seen no new locomotive device in a long time which seemed to promise such utility as this. The device has been patented by Mr. BARNES, and we shall watch its results in practical work with interest.

The Diamond Shoals (Cape Hatteras) Lighthouse.

(WITH INSET.)

We continue our illustrations of the proposed plans for constructing this light-house on the accompanying inset sheet showing chiefly the substructure details to a larger scale than the general views given in our issue of July 26. With the computations accompanying Mr. COOPER'S specifications, which appeared last week, we complete below the publication of the entire specifications submitted with bids, some occasional unimportant or merely formal sentences excepted.

We are notified by the Light-House Board that the contract has been awarded to Messrs. ANDERSON & BARR, as noticed in another column.

The remainder of Messrs. Anderson & Barr's specification is as follows:

We propose to sink the foundation 100 ft. below the bed of the shoal, as indicated on the plan furnished by the Lighthouse Board, if the material in the way of sinking the foundation is such that we can remove it by dredging. If the material is such that we must resort to the use of compressed air in order to remove it, we will sink the caisson to 80 ft. below the low water line, unless rock is encountered before that depth is reached. In that case we will quarry away the rock in such manner and to such extent as to give the foundation a firm bed on the rock. The foundation is to consist of an iron caisson filled solidly with cement concrete.

During the sinking of the caisson concrete will be filled into the same in sufficient quantities to sink the caisson as desired. When the caisson is down to its proper depth the dredging tubes, as well as the remaining unfilled portion of the caisson, will be filled full with concrete. When concrete can be put in dry it will be done so. When it is necessary to put in concrete through water it will be done with a closed bucket, with an automatic attachment for opening so arranged that it cannot be opened before the bucket is landed.

The concrete is to be made of 1 part of Portland cement, 2 parts of sand, and 4 parts of stone broken so as to pass through a 2-in. ring.

The brickwork is to be made of good, hard burned brick, equal to the best North River brick, and laid in good cement mortar, composed of 1 part of Portland cement and 2 parts of sand. All work to be done in good workmanlike manner.

Should the contract be awarded to us we will at once arrange to make soundings and borings in order to ascertain the nature of the material to be penetrated, so as to decide on the best system for removing the material, whether by dredging or by the use of compressed air. The caisson is so constructed that it may, without alteration be used in either case.

The foundation caisson is to be built of cast-iron plates with a bottom section of wrought steel. The total height is 155.5 ft. The wrought steel bottom section is of cylindrical shape, 54 ft. diameter and 30 ft. high. On top of this is bolted a cast iron conical section 20 ft. high, of 54 ft. lower and 45 ft. upper diameter. On top of this is placed the main body, which is of cylindrical form and of 45 ft. diameter, and which continues of even shape to the level of the base of the lighthouse tower.

Through the whole body of the caisson parallel with its axis pass 4 water-tight steel cylinders of 9 ft. diameter, through which the ground is excavated from under the the caisson.

At 19 ft. height from the bottom edge of the caisson these cylinders widen out into irregular conical shapes, which end at 2 ft. 9 in. above the bottom of the caisson in the circumferential cylindrical shape, and in a cross bulk head of 3 ft. height, which divides the area on the bottom of the caisson into 4 equal sectors of the circle.

Thus for 2 ft. 9 in. height the bottom of the caisson consists of a single thickness of cylindrical outside plates, and bulkheads consisting of a single thickness of plate which divide the area of the circle into four equal parts, each of which is provided centrally over it with an open vertical tube of 9 ft. diameter for the purpose of dredging its quarter compartment. The bottom circle of cylinder plates of 6 ft. height is of ¾ in. thickness.

The cross bulkhead plates are of ⅝ thickness. These central straight plates, as well as the outside circle plates, are provided with stiffening brackets of ⅝ thickness and 4-in. angle irons. All the other plate of the wrought bottom section is of ½ in. thickness, both the outside cylinder and the interior cones and tube ends. Four-inch angle irons, running vertically the whole length of the section, and 4 ft. apart, are riveted to the interior of the cylinder, and corresponding ones to the conical bottoms, and the dredging tubes are braced together by 4-in. angle iron bracing in such form as to generally stiffen the structure against both outside and inside strains. Similar angle irons brace those portions of cones and dredging tubes together which face one anotner. The top of the wrought section is provided with a 6-in. angle iron on the inside of the cylinder, to which the cast iron cone is bolted. This cone, as well as the cylindrical portion of 45 ft. diameter above the cone, consists of cast iron plates of 1⅛ in. thickness, and of such horizontal length as to make the circumference of 20 plates and of 5 ft. height.

The plates are provided with planed flanges forming 6 in. depth of joint all around them, strongly bolted together with 1-in. bolts and nuts, and laid so that the vertical seams of different layers break joints. Lugs are cast on the plates from which 4-in. angle iron braces run to the nearest of the 4 central tubes. These latter are of a uniform diameter of 9 ft., made of ¼-in. plate in sections 5 ft. high, like the outside plates, and provided on top and bottom with 4 in. angle iron outside rims for joining them by means of 1-in. bolts and nuts.

The braces from the cast iron circumference plates are attacked to these rims; also braces by which the tubes are braced to one another. For convenience of transportation and erection the cylinders are in halves, joined by 4-in. angle irons and 1-in. bolts on the vertical seams. These tubes extend up to 2 ft. above the high water line, and above that point the circumference plates are braced by turnbuckle bolts of 1¼-in. diameter.

The whole interior of the caisson, including the tubes will be filled with cement concrete, except that seven cylindrical vaults will be built in the floor of the tower. On the top surface of the concrete a cast iron base of 42⅛ ft. outside diameter and 2 ft. width, and 1⅜ in. thickness, will be placed, on which the tower will be erected. [The specifications for the tower were published in our issue of July 26.]

Messrs. Anderson & Barr also furnish us with the following table of the total estimated weight of their structure:

	Lbs.
Wrought iron	384,300
Cast core	246,500
Cast main cylinder	1,114,600
9 in. tubes	215,000
Braces	36,000
Bolts	39,000
Iron tower proper	388,000
Floor beams and frames	29,000
Brickwork	1,390,000
Total (1,916.2 tons)	3,832,400

Concrete, about 10,000 cu. yds., or about 16,911 tons (of 2,000 lbs).

Messrs. Theodore Cooper & Co. specify as follows in regard to the foundation:

The caisson of the general form and dimensions shown upon the plans will be built inside of the inlet. Upon the caisson will be erected about 20 ft. (dependent upon the maximum draught that can be easily taken over the bar at that time) of the wrought iron shell or coffer dam and tubular working shafts. Also a working scaffolding

ower for carrying the necessary engines, pumps, derricks, etc.

In this condition the caisson will be towed to the proposed site and grounded and securely moored, and the filling with concrete commenced as promptly as possible. In order to give the iron coffer dam its maximum power of resistance in the shortest time, the concrete, after several feet has been laid uniformly over the whole base of the proposed monolith, will be built up in a ring about 6 ft. thick around the whole periphery.

At the same time that the coffer dam is being filled and weighted with concrete the sand will be removed from the several chambers to allow the caisson to sink. The excavation will be either by dragging through the working shafts or by use of compressed air, as may be found best; the working shafts and machinery being designed to admit of either method, or of changing from one to the other.

As the excavation will probably be much easier than the filling process, it is proposed to force the caisson as deep as possible into the sand upon the approach or expectation of a storm by flooding the coffer dam through valves arranged for this purpose. After the cessation of the storm, additional rings will be added to the coffer dam and the interior pumped out, so that the concrete can be laid in the open air.

The proposed concrete ring around the periphery of the coffer dam will not only strengthen the coffer dam against the force of the storm, but will insure the coffer dam against the water pressure when pumped out in this condition.

After the caisson has reached a satisfactory depth the chambers and working shafts will be filled with concrete and the monolith carried up to the proposed height, with the proper anchor bolts embedded in the same, for securing the light tower.

Should the delays contingent upon the condition of the seasons and other obstacles be such that the founding of the sub-base cannot be completed in one summer, we propose to fill completely the interior of the coffer dam up to the water line with concrete, excepting the working shafts and chambers. These shafts and chambers will be filled with sand to prevent unequal settlement of the structure. All the coffer-dam scaffolding, etc., above the water line will be removed.

As we shall be able to get the caisson below any possible scour in the one season, we have no question of the ability of our substructure in this condition to resist with perfect security the winter storms.

If the sub-base can be completed by the end of one season, we believe it would be desirable to submit it to one winter's storms to consolidate perfectly the whole work, including riprap, before proceeding with the erection of the tower. The extra hazards and difficulties are practically ended upon the completion of the sub-base; the erection of the light tower being comparative a simple matter.

SPECIFICATIONS FOR CONSTRUCTION.

THE CAISSON will be formed of timber, and will be provided with a cutting edge of wrought iron plates and angles, as shown on general plan.

The timbers will be generally 12 × 12-in. scantling, laid in courses alternating in direction, and securely tied together with screw and drift bolts. The cutting edge will be firmly secured to the walls of the caisson by screw bolts with countersunk heads. The ceiling courses will be caulked and pitched. The outer surface of the caisson will be sheathed with plank running vertically; the lower ends of the sheathing plank being covered by the vertical web of the cutting edge. The interior surfaces of the several chambers and the roof of the caisson will be sheathed with tongued and grooved ceiling boards. The lower timber of the outer walls should be of white oak. The remainder of the timber of the walls should be of yellow or white pine. The roof shall be of yellow or white pine, hemlock, cedar or some equally satisfactory timbers. All the timber to be first-class in character.

Reasonable changes may be made in the details of the construction, as shown, if a better resulting floatation without detriment to the necessary strength and stability can be obtained.

The timber of the interior cross walls will be so arranged that passageways from one chamber to another can readily be made when found desirable or necessary. All of the timber of the caisson will be painted with two coats of fernoline, or equally good paint, before being put together to protect them from the teredo and to prevent absorption of water to obtain maximum buoyancy.

The coffer-dam shell shall be of wrought iron plates and angles arranged in segments which can be securely bolted to one another on the inside side, but be flush on the exterior, excepting rivet heads.

The wrought iron plates will be ⅜ in. The angles will be 4 × 3 × ⅜ in. The angles and plates of each segment will be securely riveted together with ¾-in. rivets, spaced 3 in. pitch. The segments will be bolted with ¾-in. bolts at intervals of about 3 ins. All joints of the segments will be faced or fitted with suitable packing to make the shell water tight. The lower ring of the segments will have a heavy angle iron flange, and be rigidly and securely bolted to the timber of the caisson by screw bolts. The dredging tubes will also be made of wrought iron plates and angles, each segment being securely riveted together by ¾-in. rivets, not exceeding 3-in. pitch. The several segments will be bolted together through the angle iron flange by ¾-in. bolts and caulked to be water and air-tight.

The plates and angles will not be less than ¼ in. thick and must be capable of resisting the greatest expected air pressure in case the pneumatic method is found necessary or desirable. The caps and airlocks to be attached to these tubes when air pressure is used will be of wrought iron and capable of standing safely the maximum air pressure

THE CONCRETE to be deposited with the coffer-dam shell will be composed of 1 part of cement, 2 parts of sand and 4 parts of broken stone, and will be laid in the open air. The concrete for filling the chambers of the caisson and the dredging tubes will be the same, excepting the broken stone, which will be only three parts. All the materials are to be of an improved quality and character. They are to be thoroughly incorporated with a suitable amount of water and laid immediately after mixing in layers not exceeding 10 ins. for that laid within the coffer-dam. That deposited in the chamber and tubes must be lowered into place with suitable buckets or apparatus to avoid the separation or wasting of the material. In the hearting of the sub-base, large stone may be incorporated with the concrete, but no stone must come within 6 ft. of the outer shell, and they must be thoroughly incased in cement, concrete or mortar.

The lower edge of the caisson must be sunk either 45 ft. below the surface of the sand at the site or 70 ft. below mean high water, unless a hard stratum with sufficient resistance to support the structure and resist the scour or displacement by the sea be sooner met with.

The following additional stability computations have not yet appeared:

STABILITY OF LIGHT TOWER.

The only forces affecting this will be the wind forces. Maximum moment of the wind force will be at the base of the iron tower and will equal 151,800 lbs. × 56 ft.=8,500,800 ft -lbs. = 102,009,600 in.-lbs. This must be taken up by a ring of metal 32 ft. = 384 in. in diameter.

Moment of resistance of such a ring = R 115,200 t.

Where R = strain per sq. in. and t = thickness of metal in ring.

$$\frac{102,009,600}{115,200} \text{ in.-lbs.} = R \text{ or } R = \frac{900}{t}.$$

If t = 1 in., R = 900 lbs. per in.

Total load of tower = 1,045,000 lbs., divided by area of ring = 1,200 sq. in.; strain from superimposed load would be 870 lbs. per sq. in. Maximum strains therefore on the iron ring would be

Tension, 900 − 870 = 30 lbs. per in.

Compression, 900 + 870 = 1,730 lbs. per in.

ANCHORAGE OF TOWER TO MONOLITH.

For this case we will suppose no load on floors, and only iron work in place, at the moderate estimate of 480,000 lbs.

The greatest tension will then be 900 lbs. − 400 = 500 lbs. per lin. in. of circumference, which can be abundantly provided for by the usual anchor bolts, 1¼ in. diameter, every 8 to 10 ins. around the circumference

The apparent discrepancy between the drawing and the figured dimensions of Mr. SOOY SMITH'S design as shown in our issue of July 26, may be here explained. According to Mr. SMITH'S specifications, his caisson and crib combined is to be only 30 ft. high, and its extreme depth below low water only 64 ft. By the drawings, however; the crib and caisson combined appear as 40 ft., with the bottom 74 ft. below low water. As the only available compromise we gave the drawings as they were, and the figured dimensions as they were stated in the specifications.

Mr. WM. SOOY SMITH specifies as follows in regard to the substructure:

FOUNDATION.

THE FOUNDATION shall be octagonal in plan, with vertical sides. It shall be 45 ft. across the least diameter. It shall be sunk at least 64 ft. below mean low tide, or 40 ft. into the shoal. It shall be built of Virginia pine, according to the accompanying plans. The lower 13 ft. shall be a pneumatic caisson, having a chamber 7 ft. 6 ins. in height. The walls of this chamber shall consist of, first an outside course 15 ins. thick, running vertically and bolted to the roof, and, second, a horizontal course 15 ins. thick, the timbers being halved to each other at the corners, and, third, a vertical course of 4-in. plank, which shall be caulked. The remainder of the chamber shall be lined with 3-in. plank and caulked. The chamber shall be braced across by timbers 15 ins. square, which shall be attached to the walls by brackets and bolts in such a way that they will resist both tension and compression.

The roof of the caisson shall be 5 ft. 6 ins. thick, the upper and lower courses being 3-ins. plank caulked, the remaining depth being 5 courses of 12 x 12-in. timbers, all courses in the roof and elsewhere being at right angles to the adjacent courses.

The crib above the caisson shall have the same size in plan as the caisson, and shall rise to 10 ft. below shoal surface. The outer wall shall be 2 ft. 3 ins. thick, the outer course being 3 ins., and the other two courses each of timbers 12 ins. square, the outer and inner courses being vertical.

There shall be eight cross walls, extending from the middle of each side, parallel to the adjacent side. These form an interior octagonal space, which shall form the machinery rooms during the first part of the sinking of the caisson. The timbers forming the walls of this room shall be covered on the outside with caulked plank. The timbers in the caisson and the crib shall be securely bolted together with screw bolts at intersections and with drift bolts 1 in. square and 22 ins. long, spaced about 4 ft. apart The plank shall be fastened to the timbers with spikes 7 ins. and 9 ins. long, there being at least one spike for each square foot of surface. The angular space between the octagonal walls shall be filled with concrete.

To the top of the crib there shall be attached a cast iron cylinder 36 ft. in diameter and 71 ft. high. It shall be anchored to the crib by the interior mass of concrete and also by bolts 2 ins. in diameter and 10 ft. long, which shall have at their lower ends cast iron anchor plates 12 ins. in diameter, or shall be attached to timbers built into and forming a part of the crib. The cylinder shall consist of 8 sections, each section being 8 ft. 10½ ins. in height and containing 32 plates. These plates shall be 1¼ ins. thick, with flanges on all sides, and a horizontal rib at the middle of the height. The flanges and ribs shall be 1½ ins. thick and 6 ins. wide, measuring from the face of the plate, except the bottom flange of the bottom section, which shall be 2 ins. thick and 12 ins. wide.

The plates will be fastened to each other by 1-in. bolts spaced 12 ins. on the vertical edges and about 10 ins. on the horizontal edges. The joints between the plates shall be packed with tarred hemp to a thickness of 1-16 in. The plates shall be of such quality of iron as will be strong and best withstand corrosion by sea water. They shall be true to pattern, free from sand holes or blow holes, roughness or irregularity.

The crib and cylinder shall be filled with concrete excepting such space as is occupied by the cistern. The concrete in the cylinder extending 4 ft. from the shell shall be of the best Portland cement and clean sand taken from the shoal. The proportions being 1 part of cement to 3 of sand. The remainder of the concrete shall be of the same ingredients, but the proportions shall be 1 of cement to 5 of sand.

The concrete shall be mixed by suitable machinery and when deposited shall be well tamped in regular courses not to exceed 10 ins. in depth.

Twenty-five tons of steel railroad rails will be placed in the concrete filling of the crib and cylinder in such positions as will give the greatest resistance to cross strains on these parts of the structure.

The chamber of the pneumatic caisson shall be compactly filled with sand. The structure shall be surrounded by riprap, and in this and all other matters not herein specifically described the work shall be done in accordance with the general specifications issued by the Light House Board.

METHOD OF CONSTRUCTING AND SINKING THE FOUNDATION.

Four boats of suitable dimensions and construction will be joined together by bolts, easily removable, inclosing a space large enough to receive the caisson forming the bottom of the caisson. A strong water-tight floor shall be placed in this space and united by removable bolts to the boats, making water-tight joints with them, so that the boats with this floor shall form a dry dock in which to build the first 60 ft. in height of the foundation, and to transport it to the site from the nearest safe harbor.

Such form and size will be given to this dry dock as will give it the displacement necessary to carry out the structure with the draught permitted by the least depth of the channel to be used, and to prevent its capsizing in a seaway when carrying the structure into position. When the portion of the foundation described has been completed in the dry dock, the machinery to be used in sinking the foundation will be placed in the rooms provided for it in the crib, and coal, water, provisions and materials to be used in construction will be stored in the rooms and cells of the crib work surmounting the caisson.

The machinery will consist of boilers, engines, air compressors, steam pumps, sand pumps, electric light apparatus, hoisting engines, derricks, and in short an abundance of everything necessary to proceed with the sinking of the foundation with great rapidity as soon as it has been placed in position. A sufficient number of powerful tugs will then be employed to tow the dock with its load to the site, accompanied by a sufficient number of vessels carrying materials, supplies, stone fascines and mattresses for riprapping and everything that can be needed for the vigorous and successful prosecution of the work so long as the weather may permit them to remain near it.

Having arrived at the site, the structure shall be securely anchored in position. Valves in the dock provided for the purpose will then be opened, and it will be allowed to sink to the bottom. The removable bolts uniting the sections of the dock with each other and with the floor will then be taken out, and the boats constituting it will be removed.

Compressed air will then be forced into the working chamber of the caisson until the water is driven out of it,

when workmen will descend into the working chamber and remove the floor from beneath it. As soon as this has been done the blow-out pipes and sand pumps will be put in operation and the sand and water carried up by them discharged into such compartments of the crib (not required for storage purposes) as have been prepared to receive them. In this way the load necessary to compensate for the increasing displacement of the structure as it sinks will be provided, without the delay incident to supplying it from outside.

While this part of the sinking is in progress gangs of skilled laborers will build up the structure at the top, using the plates and other materials necessary, brought out in the cells of the crib work. As fast as these cells can be emptied of these materials they will be filled with concrete. The cells filled with sand pumped and blown from the bottom of the caisson will also be filled with concrete as rapidly as this can be done, the water having been first pumped out of them.

While these operations are all in harmonious progress, materials will be transferred from the vessels in attendance to the structure, which will be kept as far as practicable above water surface and securely covered by a movable deck.

As soon as the caisson has been sunk to a depth of 40 ft. below water surface the riprapping will be begun and pushed vigorously to prevent danger from the scouring of the bottom by waves and currents. There will be air compressors of sufficient capacity to operate five 5 in. blow-out pipes simultaneously, and steam pumps enough to run the same number of sand pumps with 5 in. discharge pipes. With this provision of machinery it will be perfectly practicable to excavate 2 cu. yds. of sand per minute, and if no sand flowed into the structure at the bottom, this would enable us to sink the caisson about 1 ft. per half hour. With liberal allowance for inflow of sand and other contingencies the practicable rate of sinking cannot be less than 1 ft. per hour. At this rate the structure can be sunk very quickly beyond all danger of undermining by the scouring effect of waves and currents, after which the completion of the lighthouse will be but a question of time. The sinking will proceed as rapidly as the weather and other circumstances will permit, a stanch vessel being kept constantly in readiness to render any help that the force engaged may need. As the sinking proceeds the structure will be carried up and filled until the requisite depth is reached.

The Ries Electric Traction Increaser.

Does the passage of an electric current from a wheel to the rail upon which it rests or rolls increase the possible traction with that wheel under a given load in practical service? This is a question which has been confidently answered in the affirmative by reputable engineers, and as confidently disputed by men of equal reputation.

The results of careful experiments are said to have absolutely proved the theory, while other careful experiments are said to have wholly disproved it. On the whole, the burden of evidence is in favor of there being some possibility here which may prove to be of practical importance, and which imperatively demands further practical investigation.

Perhaps the strongest evidence that the electric current does increase the coefficient of friction was given in a paper read a year ago by Mr. LEO DAFT before the American Institute of Electrical Engineers, from which we quote as follows:

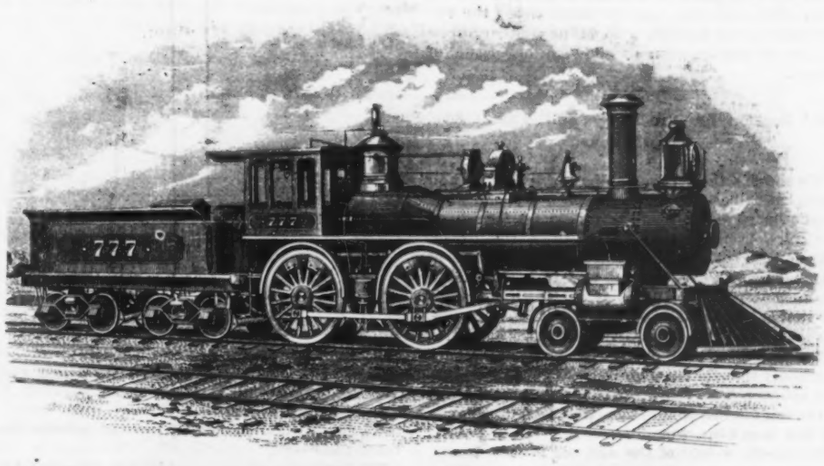
During a series of experiments with small motors made at the works of the Daft Co., at Greenville, N. J., in 1882, I constructed an adjustable incline, upon which a small motor was caused to ascend, with a gradually increasing gradient until the extraordinary grade of 2,900 ft. per mile, or 54.9% was reached. Up to this point the motor (weighing 450 lbs. plus one man weighing 150 lbs., total 600 lbs.) was readily started from a position of absolute rest at the bottom, and ascended the gradient, being occasionally stopped midway and started again with perfect ease. When this final gradient was reached, however, the ascent was less easy and certain, though it was accomplished several times; but an attempt to exceed it resulting in failure, this was regarded as the maximum under these conditions.

Now let us for a moment consider what this actually indicated. A motor having a total weight of 600 lbs. will have a rolling resistance certainly equal to 10 lbs. per ton [probably more—ED.], making 2.25 lbs. for this item; at 54.9%, the grade resistance will be 329.4, making a total of 331.65 lbs., or 55.27% of the total weight [This is in error, unless the "horizontal" distance was measured along the incline. Otherwise the gravity resistance would be 43.1% of the rate of grade, or 258.6 lbs. for 600 lbs. The moral of the comparison is not materially altered by this change, however.—ED.], considerably more than double the ultimate working limit of adhesion under the most favorable conditions cited by WELLINGTON in his "Economic Theory of the Location of Railways." [This statement also is not quite correct, the ultimate of possible natural adhesion is some 35%.] But as these conditions, namely, a perfectly dry rail with drivers absolutely free from any lubricant, are so rarely found in practice as to be scarcely worth taking into account in every-day work, it may fairly be considered as equal to three times the ultimate effort usually developed before slipping occurs. [This statement also is slightly overdrawn, but not enough to vitiate the natural conclusions.—ED.]

That the motor should not have ascended the gradient I am well aware—indeed, out of the commonest respect for such authorities as Messrs. CLARK and WELLINGTON, it ought to have stopped at the bottom of the gradient, meekly rotating its wheels, but I was confronted by the indisputable fact that it did go up, and did it every day with perfect regularity for a number of days, before many gentlemen, among whom were mechanical engineers, who could not account for that state of things at all—and, frankly, neither could I; but as a cold fact it outweighed all the arguments in the universe.

In the discussion upon this paper Mr. T. COMMERFORD MARTIN testified that he had seen the tests above referred to by Mr. DAFT and his own doubts were as great as possible until he saw the motor actually ascend the grade with Mr. DAFT himself on board.

Mr. DAFT stated, however, that he by no means asserted that either the dynamic or static adhesion of a large locomotive could be increased to this extent under the conditions of ordinary practice. The remarkable results in this case were due to the use of "a very large current of low potential, passing through the very small contact areas presented by wheels 1 ft. in diameter rolling on a 16-lb. rail. The effect is, however, undoubtedly obtainable to the extent of at least 30% under the ordinary conditions of railroad practice."



LOCOMOTIVE WITH THE RIES ELECTRIC TRACTION INCREASER.

The chief experiments proving that the electric current has no practical effect were made by Messrs. O. T. CROSBY and BENJ. J. DASHIELL, and while they were regarded by the experimenters as conclusively proving the absence of increased traction by the use of the electric current, they were objected to by other electricians, among them Messrs. DAFT and MARTIN, as being not wholly satisfactory. It is needless to say, however, that if one man established by proof that he has produced a certain effect, it by no means invalidates his testimony if any number of men try to produce the same effect and fail.

Among the electricians who have had firmest faith in the power of the electrical current to increase the possible tractive effort of the wheel is Mr. ELIAS E. RIES, of Baltimore. He has turned his attention mainly to the possible use of the electric current in connection with an ordinary locomotive to form a traction increaser of unexampled efficiency. The results of his experiments have been such that a stock company has been formed, as noted in our issue of July 19, to develop Mr. RIES' inventions and place them on the market.

At the recent Master Mechanics' Convention at Old Point Comfort, and at the Railway Telegraph Superintendents' meeting at Niagara Falls, a model of Mr. RIES' invention was exhibited, in which a small motor was enabled to climb grades of 20 to 45 per cent. when the current was turned on; whereas, without the current grades considerably less than 20% could not be surmounted. In pulling on a level the motor exerted a traction of 5 to 6 oz. when the wheels began to slip, and when the electric current was applied 24 oz. were pulled before slipping began. This remarkable increase in tractive capacity was obtained as easily when the rails were wet, soaped, or oiled as when they were dry.

At the meeting last mentioned a paper was read by Mr. CHAS. SELDEN, Superintendent of Telegraph, Baltimore & Ohio R. R., who exhibited the motor, in which after showing the results obtained with the model, he alluded to the fact that it had yet to be proven whether what was true of the model would be true also of a full-size locomotive. He stated further that one trial of Mr. RIES' invention had been made upon a locomotive, and referred to it as follows:

The reports upon the subject, while tending to show possibly a slight effect, did not show an effect so appreciably large as to warrant the statement that it had been successful. To my mind, however (being acquainted with the circumstances and with the amount of electric power used on that occasion), I do not consider the test as having been in any way fair to the device. A dynamo built for a 35-ton engine was placed on a 65-ton eight-driver; and, to my mind, it almost was the same as trying, with a few cells of battery, to perform the work that a dynamo is called upon to perform in arc lighting.

So much for the pro and con of the question whether traction-increasing by electricity is possible. That an electric current of large volume and low intensity does increase the coefficient of adhesion with small motors is evidently well proven. Whether an effect great enough to be of value can be obtained with ordinary locomotives without the employment of too heavy machinery and the use of too much power, remains to be seen. The result of Mr. RIES' experiments, now in progress, will be awaited with interest.

In the accompanying engraving the mode of application of the Ries Traction Increaser to an ordinary locomotive is illustrated. The following description of the mechanism is given by the *Electrical Engineer:*

An alternating current dynamo is used, driven by a rotary engine furnished with steam from the locomotive boiler. The engine and dynamo are mounted upon a common base secured to the boiler in the position formerly occupied by the sand box. One or both pairs of driving wheels are electrically insulated from the body of the locomotive and from each other by the use of special insulation surrounding the driving box and side rod brasses. The insulation so far employed has proven itself fully capable of withstanding the exceptionally severe strain to which it is subjected, and tests made after several months of continuous service have led to its permanent adoption for this class of work.

Electrical connection with the two pairs of drivers is maintained by means of peculiarly constructed brushes bearing upon brass sleeves secured to the central portion of each driving axle. These brushes are connected, by means of heavy stranded copper conductors, with the source of low tension current, which in the case illustrated is a transformer (not shown) placed in close proximity to the main driving axle. A type of machine is now

about to be used, however, which generates directly the low tension quantity currents required. As the resistance of the traction-increasing circuit is practically constant under given track conditions, the flow of current is usually regulated by varying the electro-motive force, which, on account of the low resistance of the circuit and multiple connection of the driving wheels can be kept very low. The current density at the points of contact between the driving wheels and rails can be varied at will, according to the percentage of increased adhesion desired, the usual range, being from 500 to 2,500 ampères.

It is proposed to use part of the current generated by the dynamo, either directly or indirectly, according to the type of machine employed, for the operation of electric locomotive and train brakes, electric headlight and train lighting, etc., in addition to its use for increasing traction. The dynamo is generally kept running at a slow rate of speed when not otherwise employed, and is so constructed as to respond promptly and automatically to any demand that may be made upon it within the limits of its capacity.

This much we may say: that there is probably no improvement which could be applied to the locomotive which promises such great results as an *effective* traction increaser. Mechanical devices to increase traction have been open to the objection that they increased to a dangerous degree the weight upon a single axle. One of the most important reasons for the economy with which American railways are operated is the large train load hauled. If the electric traction increaser is successful in accomplishing what is hoped for it, the way will be open for a further large advance in this direction, with resulting gains in economy of service, which, from a financial view, are of many times the importance of any possible gain in any other direction, as we had occasion to show in our issue of Aug. 2.

Rail Section for Broadway and Third Ave. Cable Tracks.

We show in the accompanying engraving, to half scale, the rail section which has been recommended by the Board of Railroad Commissioners for use on the Third Avenue Railroad and also on the Broadway and Seventh Avenue Railroad, and the use of which is made a condition of the authorization to use a cable. The conditions as set forth in detail are that the head shall be not less than 2 ins. wide, the groove not over 1¼ ins. wide at the top and ⅝ in. at the bottom, and not over 1 in. deep to lowest part of groove; that the lip shall be at least ⅝ in. wide and not over $\frac{5}{16}$ in. below the head; the whole depth of the rail not less than 7 ins. and the lower flange not less than 4 ins. wide.

The precise weight of the rail we do not know. Its sectional area, as nearly as we can determine it by the planimeter, is 8.06 sq. ins., from which its weight should be somewhat over 82 lbs. per yd.

The terms of the instrument granting permission for the construction of the cable line are in substance as follows:

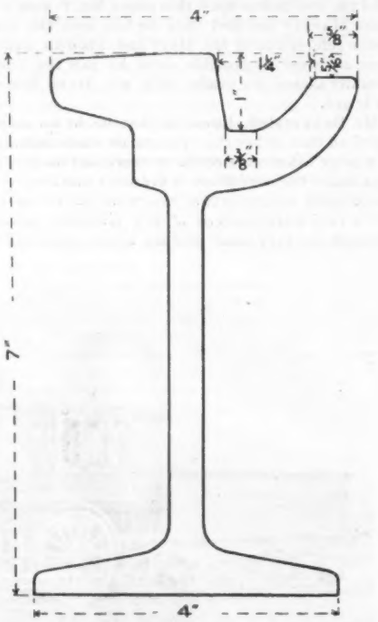
The Common Council of New York granted authority to construct the line Nov. 12, 1889, by recommendation of the Mayor and Commissioners of the Sinking Fund, on conditions which have since been accepted, viz., that by bond of $500,000 the company should agree that its total payments to the city under existing provisions shall be at least $150,000 per year, so long as there is no other road on, under or over Broadway; that by bond of $100,000 the company shall keep the city harmless from all damage suits, and that the cable system shall be a duplicate one, upon the plans exhibited, as follows:

The conduit to be a tube of steel with an open slot of ⅝ in. at the surface, 2 ft. 6 ins. deep, and 1 ft. 6 ins. wide at the widest part; to be surrounded by a continuous bed of solid concrete 6 ins. in thickness. Every 4½ ft. there will be an iron frame or yoke further supporting the concrete and the rails upon the surface of the pavement, and this frame will in turn be supported by a solid bed of concrete 6 ins. in thickness. Side-bearing rails to be used, and the space between and immediately outside of the rails to be paved with granite blocks of the same dimensions as those prescribed for the pavement of the remainder of the street, and resting upon the solid mass of concrete and iron frames which surround the conduits, so that the relative positions of the paving stones and the car rails cannot be changed by frost or use.

The application then goes on to describe at length the construction in detail, which we shall show later more fully. Suitable driving plant, machinery and engines in duplicate are to be provided.

The consent of $63,000,000 out of $125,553,966 of assessed valuation along the route is shown to have been obtained. There was no opposition to the grant.

In view of these facts the Railroad Commission grant authority for the change from horses to cable, conditional on the company repairing and maintaining the pavement between the tracks and for 2 ft. outside, paying for all necessary changes in sewers and pipes beneath the street, using the rail stipulated, wholly removing snow from its tracks and not throwing it to one side, following the speed prescribed by the local authorities, conforming to all other reasonable requirements legally imposed by the local authorities, and providing a guard in front of the wheels coming within an inch of the



Section of Rail for Broadway and Third Avenue Cable Railways.

track, which shall effectively prevent persons from being run over.

The further condition is made that the Grand St. cross-town line shall be at liberty to use the cable for a short distance (23d to 34th St.) on equitable terms, and run its own cable in the conduit if practicable.

Making Copper Tubes by Electricity.

We described last week the remarkable Mannesman process of tube making which has attained such success in Germany. In a recent number of *Engineering* another extremely novel process of tube making is described, which for the production of copper pipes of large diameter seems to promise to become of much practical importance.

The process is the invention of WM. ELMORE, and consists of the deposit of copper from a solution of copper sulphate by the action of electricity. The copper thus deposited is, of course, of absolute chemical purity; but, what is of greater practical importance, its toughness is marvellously increased over that of the common metal. Ordinary rolled copper has an average tensile strength of 30,000 to 34,000 lbs. per sq. in. The electro-deposited metal, however, according to tests made by Prof. ALEX. B. W. KENNEDY, has an ultimate strength of 58,000 to 60,000 lbs. per sq. in., a limit of elasticity of 50,000 to 55,000 lbs. per sq. in., and an elongation of 14 to 17.5% in 4 ins. The reduction of area at the point of separation was 66 to 70%, and the fracture was of silky appearance.

Certainly a metal with these qualities is of manifest value to engineers, especially as the tubes made from it are seamless, and their integrity does not depend on the strength of a brazed joint, which may or may not be an honest and careful job. With the high pressures of steam and large engines now generally employed in marine service, failures of copper steam pipes are becoming increasingly common. For marine use especially, therefore, it is expected the new process will be of great value.

The process of manufacture is thus described by *Engineering*:

Every one is aware that copper can readily be deposited from its solutions. Practically all the crude copper which comes into this country is refined by electric deposition. By means of currents derived from large dynamo machines the Chili bars are dissolved, the pure copper being thrown down on the cathodes in rough nodular masses, and the impurities, often containing gold and silver, being left as mud in the bath. The refined copper has afterward to be melted, with the chance of oxidizing it, cast, and rolled into bars or sheets. If it is desired to obtain the copper of soft quality and even texture it is necessary that the process be carried on very slowly indeed If any attempt be made to hurry it the result is a coarse granular metal entirely wanting both in strength and ductility.

The copper electrotypes of the engraved plates for the Ordnance Survey maps as well as the plates themselves were deposited with a current of 6 ampères per sq. ft. Now as each ampère deposits .00330075 grams per second, it follows that, working night and day for 6 days (144 hours), there would be deposited on a square foot 1,026 grams, or about 2¼ lbs. of copper. This would give a plate $\frac{1}{20}$ in. thick. What the tensile strength of such a plate would be we do not know, but since many large copper manufacturers have tried to utilize the process for the production of tubes, and have abandoned it, it would seem that the metal was of inferior quality in some important respect, or else the cost was prohibitive. At the Ordnance Survey office the cost of such copper, made from anodes of the best quality, is stated to be 1s. 5d. per pound, but unless we know on what principle the books are kept, and whether due allowance is made for rent and depreciation, these figures may be misleading.

The Elmore tubes are deposited at the rate of ⅛ in. in thickness per week of 144 hours, or 6 lb. per sq. ft. of surface. The process by which they are produced differs only in one respect from that hitherto followed in the electro-plating of rollers for calico printing machines. The surface of the copper is continuously burnished by an agate the whole time; and as rapidly as the particles of copper are formed they are rubbed and matted into those beneath and beside them, thus forming a fibrous plate of perfectly uniform structure and great strength. So closely are the particles interlaced that the specific gravity is increased until a plate one-eighth of an inch thick weighs 6 lbs. to the sq. ft.

As the mandrel on which the tube is formed rotates in the bath of copper sulphate, the agate travels along it, forming a fine spiral on its surface, the speeds being so arranged that only a very fine film can form between two applications of the burnisher to a given spot. The physical properties of the metal depend to a certain extent upon the rate of deposition and the thickness of the film burnished. This last is usually 7-1000 in., but it is subject to variation. For instance, steam tubes are usually thickened up at the ends for the flanges to be attached to them. To this end the anode of common Chili bars is placed nearer to the ends of the tube than to the rest of the length. The electric resistance is therefore decreased at those points, the result being an increased density of current and a thickening of the tube. The ends are thus rendered thicker and softer, so that they can be very readily flanged.

These flanges do not serve alone for the union of successive lengths of pipe. Gun-metal flanges with grooves in their faces are are first slipped over the cylindrical tubes, and then the ends are rolled over into these grooves, into which they fit exactly. By varying the position of the anode other alterations of form can be effected. For instance, when it was intended to bend the Elmore tubes by the ordinary process it was proposed to make them thicker down one side than the other, so that the stretching which takes place on the other side of the bend should not reduce the general strength. To do this the mandrel would have been mounted eccentrically, the result being that the side which approached nearest to the anode would have been the thicker of the two. However, since the introduction of the Fowler bending machine it is not necessary to do this. This machine, an American invention, will bend a pipe of any size without extending the metal on the outer side of the curve. In place of this it sets up or thickens the metal on the inner side.

Electrically deposited burnished copper may, of course, be applied for many purposes besides steam pipes. Indeed, since all copper is electrically deposited, and the burnishing only takes the place of remelting and casting, it is quite possible that the new process many serve for the preparation of every variety of copper goods. One of the uses for which it is being prepared is that of electric conductors. By cutting a tube up spirally there is produced a square filament which can be drawn down in the dies until 40 miles only weigh 1 lb., and that, too, without annealing, and so pure is the quality that its conductivity exceeds the best article in the market by 4%, and is actually 2% better than the standard prepared with the utmost care in the laboratory. Pans of all kinds can also be made by the process at a cheaper rate than by brazing

or riveting. Pump plungers and hydraulic rams can have coats of copper applied directly to them, and if their surfaces are cleaned and grooved, the union of the two metals is as firm as if they were welded. This intimate connection is avoided in the case of tubes by coating the mandrel with black lead. After it is taken out of the bath the copper is rolled: this has the effect of causing it to expand, when it can be easily slipped off the center.

The burnishing of electrically-deposited metal is a process which may eventually be applied to other substances than copper. It is quite evident that it would improve the union between a protective outer metal and a base of inferior metal, and that it would entirely obliterate all holes or cracks. A thin coat thus applied would afford equal security with a thicker coat that was not uniform.

Since the deposited copper is made direct from Chili bars, which are simply placed in the bath and allowed to dissolve, it follows that the expense of manufacture relates chiefly to engine power and rent, labor being comparatively an insignificant item When a mandrel is put into a tank it remains there for one or several weeks slowly turning round, and only needs the slightest attention, until it is ready to be lifted out and to be replaced by another. All this time the process goes on automatically and there is scarcely any expense except that for driving the dynamo. It is certain that this cannot be great per pound of copper deposited. It requires an electromotive force of from .2 to .3 volts to effect the chemical reduction of copper sulphate solution, and if we assume the combined efficiency of engine, dynamo, leads, and bath to be only 25 per cent., then each indicated HP. will deposit 888 grams, or 1.95 lb. of copper per hour. This shows that a ton of coal used in a modern engine will deposite a ton of copper. Now, taking the Lancashire standard of 1d. per hour as the cost of rent and power, it would follow that copper could be deposited at a cost for these two items of ½d. per lb.

Certainly if the estimates of our contemporary are even approximately true, there is a wide field for this process. The Elmore Copper Depositing Co., of 29 Bucklersbury, E. C., London, has been organized to develop it, and is now taking orders for copper pipe of any size up to 3 ft. 4 ins. diameter and 10 ft. in length. Each pipe has etched upon it the results of a test which is made on a strip cut from its end, and thus the engineer is relieved from anxiety as to how it will behave.

Tire Breakages in Germany.

In a recent number of the *Centralblatt der Bauverwaltung*, appears the usual yearly article on the breaking of tires on German railways, based on statistics gathered by the government, from which we make the following abstracts.

In 1889, 4,187 tires failed on the 24,660 miles of line belonging to 41 independent systems; on each 1,000 miles of single track, 115 tires broke as compared with 139 in the previous year. During January, February and March, 63.6% of the failures of 1889 occurred. By these accidents 21 derailments and 171 delays were caused. The breaks were immediately noticed with 320 of the wheels.

Trustworthy details of the nature of the track where the failures took place have been gathered in only 2,544 cases. Using these figures, however, it would appear that 5 accidents of this nature occur on each 1,000 miles of track using bed plates or chairs, 75 on each 1,000 miles using cross-ties, and 25.5 on each 1,000 miles using longitudinal sleepers. With express trains, 167 breaks occurred; with passenger trains, 461; with mixed trains, 229; with freight and construction trains, 2,330; with unloaded cars, 87; during switching, 118. The remaining cases are undetermined.

The number of times the body of the wheel, whose tire was broken, had been used was known in 80% of the accidents. The plate had been used in 591 and the hub in 1,398 cases for the first time, the plate in 83 and the hub in 883 cases for the second time, the plate in 9 and the hub in 212 cases for the third time, the plate in 1 and the hub in 96 for the fourth time, the hub in 51, 12 and 2 cases for the fifth, sixth, seventh time respectively.

For each 100 accidents with plate wheels, 59 accidents with spoke wheels occurred when the hub was used for the first time, 266 when the hub was used for the second time, 539 for the third and 2,400 for the fourth time.

In 63.4% of the cases, the fracture was in sound, in 26.2% in faulty, and in 1% in badly welded metal. The fracture was fresh in 2,636 cases, in 1,141 cases it was old, and in 410 cases failure occurred without breaking.

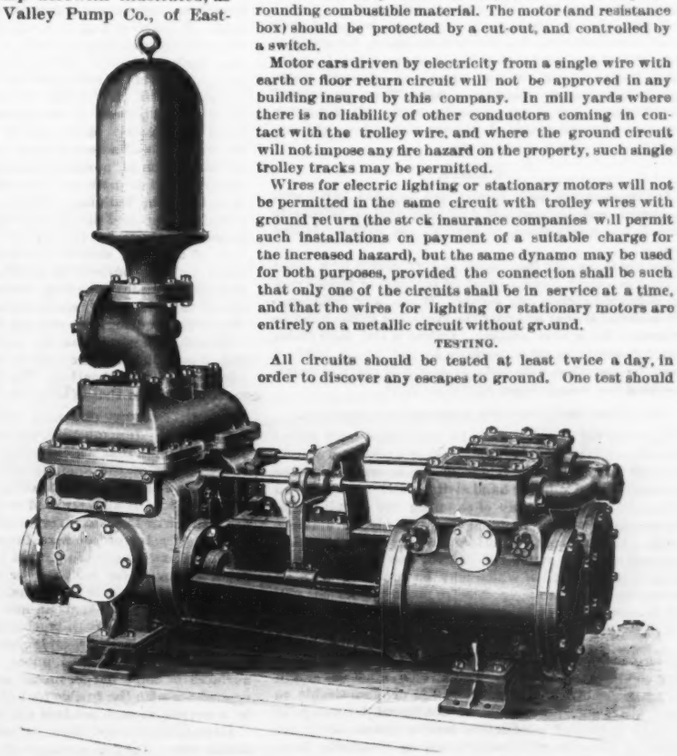
The causes of the accidents were determined in the following cases: 1,312 fractures were due to impure, spongy, or soft metal, 796 to brittle metal, 652 to the effect of heat and cold. In every 10,000 wheels of all kinds, 27 have been broken. In every 10,000 locomotive wheels, 43 broke; 51 failed of every 10,000 on tenders, 35 of every 10,000 on passenger cars, 53 of every 10,000 on mail cars, 35 of every 10,000 on baggage cars, and 25 of every 10,000 on freight cars.

As regards the material of the tires, puddle steel made the worst showing, with 68 failures in every 10,000 wheels; then came iron with 47 failures, and finally the different kinds of ingot steel (cast, crucible, Martin, manganese or Bessemer), with 27 failures per 10,000 wheels.

The different lines are now fastening their tires with some of the new methods of the Mansell type, almost entirely. A great number of the failures can be directly traced to injuries sustained during fastening. Of 10,000 tires attached in the old way, 53 failed, while with a like number of wheels using the new methods of fastening, only 12 failures were reported. About 2 per cent. of the failures occurred with tires from 0.8 to 1 in. thick; only 0.01 per cent. took place on tires of 2.4 ins. or over.

A Duplex Steam Pump.

The duplex steam pump herewith illustrated, as manufactured by the Valley Pump Co., of Easthampton, Mass., differs from the Worthington and others which use the link for moving the steam valves. The manufacturers use for this purpose a straight rod without joints, on which between two collars held in place by set screws, is a spool loose on the rod, so that it can both slide and revolve. These collars are set the right distance apart to allow the main piston to travel the proper distance without moving the steam valve. The spool is moved by the crank pin of the rock shaft working between the flanges, with the result, it is claimed, that the wearing at this point is reduced to a minimum, as the spool revolves at every motion, and so presents a much larger wearing surface than the hinge joint commonly used. The cut shown here is that of a fire pump from patterns designed for this special work, and to which it is said to have proved itself to be admirably adapted.



DUPLEX STEAM PUMP.

Regulations for the Installation of Electric Lighting and Motive Apparatus.

The Boston Manufacturers' Mutual Insurance Co. has just issued a brief pamphlet for the guidance of members of the company in the installation of electric light or motive apparatus. The same rules have been adopted by the Boston Fire Underwriters' Union and the Boston Mutual Insurance Co.

In the preface to the rules President EDWARD ATKINSON states that when electric lighting was first introduced in mills insured by the company there were 23 cases of fire in 61 installations within six months from the beginning; fortunately, however, without any loss. Rules were then prepared, after a thorough investigation, by which all the members have since been governed; but the rapid advance in electrical science and the many new inventions introduced have made necessary a complete revision of the rules. In view of the somewhat prevalent impression that electric installations considerably increase the danger from fire, the following statement of President ATKINSON is of great interest:

There has not yet been a loss from any fire which could be attributed to electricity, generated for purposes of lighting or for motive power, in any mill or works insured by this company. The experience for ten years has sustained our position that a well installed electric lighting system is the safest method of illumination.

The rules were prepared by Messrs. C. J. H. WOODBURY, F. E. CABOT, C. M. GODDARD and L. E. BARTON. We condense them as follows:

DYNAMOS AND SWITCHBOARDS.

Dynamos must be insulated upon dry wood, filled to prevent absorption of moisture, and must be kept thoroughly clean and dry. They must be provided with a reliable, automatic regulating device, or a competent person must be in attendance. In wiring for motive power, take the same precautions as with a current for lighting.

Switchboards should be so located that they will be accessible, and open on all sides, and disconnected from all wood-work or combustible material. They should be incombustible, non-absorbent of water, and kept dry.

MOTORS.

Take same precautions as for dynamos. All resistance boxes should be made of non-combustible material, or so located that they cannot communicate fire to any surrounding combustible material. The motor (and resistance box) should be protected by a cut-out, and controlled by a switch.

Motor cars driven by electricity from a single wire with earth or floor return circuit will not be approved in any building insured by this company. In mill yards where there is no liability of other conductors coming in contact with the trolley wire, and where the ground circuit will not impose any fire hazard on the property, such single trolley tracks may be permitted.

Wires for electric lighting or stationary motors will not be permitted in the same circuit with trolley wires with ground return (the stock insurance companies will permit such installations on payment of a suitable charge for the increased hazard), but the same dynamo may be used for both purposes, provided the connection shall be such that only one of the circuits shall be in service at a time, and that the wires for lighting or stationary motors are entirely on a metallic circuit without ground.

TESTING.

All circuits should be tested at least twice a day, in order to discover any escapes to ground. One test should be made in the morning and another before starting, in ample time to remove any defect.

ARC LIGHTING—OUTSIDE WIRES.

Outside overhead wires must be well insulated and firmly secured to properly insulated and substantially built supports. All tie wires must have an insulation equal to that of the conducting wires.

Joints must be fully equal electrically to the cross-section of the conducting wire, and should be soldered and wrapped with approved tape. Formula for soldering fluid: saturated solution of zinc, 5 parts; alcohol, 4 parts; glycerine, 1 part.

Conducting wires should not approach each other nearer than one foot, nor touch any substance other than air, and their proper insulating supports. If carried over buildings they *must* be at least 7 ft. above the highest point of flat roofs, and 1 ft. above the ridge of pitched roofs.

When in proximity to other wires of any sort, or any substance likely to divert any portion of the current, or where sharp angles occur in the live wires, *dead*, *insulated* guard-irons must be placed so as to prevent any possibility of contact in case of accident to the wires or their supports.

Overhead wires from the main circuit or pole in the street to the terminal insulators attached to buildings, and at the point where they enter a building, must not be less than 12 ins. apart. They must be rigidly run and supported by glass or porcelain insulators or rubber hooks.

Service blocks must be entirely covered with two coats of water-proof paint; and, when used to support rubber hooks, must have at least 1 in. of wood between the inner end of the hook and the back of the block.

For entering buildings, wires with an extra heavy water-proof insulation must be used to pass through the walls. They must loop down, so that water may drip off, without entering the building, and the holes through which they enter should, where possible, slant upward.

Wires must enter and leave the building through an approved "double contact" cut-out switch. It should be automatic in its action in either direction, should indicate upon inspection whether current be "on" or "off," and must be mounted on a non-conducting base, kept free from moisture, and easy of access to firemen and police.

ARC LIGHTS—INSIDE WIRES.

Wires must not be concealed, and they must be rigidly kept apart at least 1 ft. unless an *approved, moisture-proof, non-conducting, non-inflammable tubing* is used, sufficiently strong to protect the wires from mechanical injury. This may be fastened to the wall by stables. Wires in this class of tubing may be run as near to each each other as 3 ins.

Conductors in buildings must be insulated with non-absorbent water-proof material, as incombustible as possible, which will adhere to the wire, not fray by friction, and stand a temperature of 150° without softening.

In places liable to dampness, wires must be run on glass insulators, rubber hooks, or porcelain knobs, separated at least 18 ins., and provided with an approved water-proof insulation or tubing. When wires pass through walls, etc., in-doors, glass tubing or so-called "floor insulators," or other approved tubing, must be used. All lightning-arresters must be grounded outside of building, and preferably connected to a water pipe.

ARC LAMPS.

Arc lamps must have frames and exposed parts well insulated, and be provided with hand switch, automatic switch, and safety stops to prevent the carbons falling out.

For inside use, the lamp must be surrounded by a globe resting in a tight stand, so that no particles of melted copper or heated carbon can escape. When any inflammable material is near or under the lamp, the globe must be protected by a wire netting. Unless a very high globe, which closes in, as far as possible, at the top, is used, it must be provided with some protector or spark arrester, reaching to a safe distance above the light.

INCANDESCENT LAMPS ON HIGH-TENSION CIRCUITS.

The rules for running wires for arc lamps apply also to incandescent lamps on circuits having a potential of over 350 volts. Incandescent lamps in single series must be provided with a suitable hand switch, and also with an automatic device capable of shunting the circuit across the terminals of the lamp should the carbon filament break. When incandescent lamps are in multiple series the hand switches must not control less than a single group of lamps, each of which may be provided with an automatic shunt, as above. Electro-magnetic devices will not be accepted as suitable for this purpose.

UNDERGROUND SERVICES.

There shall not be any free opening from underground wire conduits to buildings. The service must not end in any place where it would be unsafe or undesirable to place a cut-out, but should be continued by means of specially insulated conductors (and a space of 10 ins should be maintained between them) to a suitable location.

INSIDE WIRING.

For inside work, no wire smaller than No. 16 "B. & S., or No. 18 "B. W. G.," will be approved. The use of lead-covered wire, or wire the covering of which contains paraffine, is prohibited.

Moldings with open grooves laid against the walls or ceilings will not be approved. A wood molding with dividing strips between the grooves, at least ⅛ in. thick, and having a backing at least ¼ in. thick to intervene between the wire and the wall or ceiling of the building, the backing to be protected by at least two coats of water-proof paint, and the molding of such shape as to protect the wire from moisture, will be approved. Moldings must not be used in wet places.

Wires laid in plaster, cement, or other similar finish, or run over surfaces furred off for plastering, will not be approved, no matter what insulating covering is used. An approved moisture-proof, non-inflammable, insulating tubing or conduit may be used if of sufficient size and so placed that the wires may be withdrawn and replaced at will. If the joints of the tubing are moisture-proof, a double-braided cotton insulation, rendered non-inflammable, may be used. A separate tube must be laid for each wire, except in the case of "taps," for not more than 15 ampères, in which case conductors having insulation of cotton or other material which will readily carbonize will be required. If a moisture-proof covering is desired, it must be placed outside the two conductors, and not between them.

In other concealed places, such as between floor and ceiling, etc., all wires must be covered with approved moisture-proof insulation, and fastened at distances not exceeding 10 ft., so as to preserve at least 2½ ins. between the wires or any other electrical conductor; or an approved tubing or conduit with moisture-proof joints may be used. Tubing passing through walls or ceilings must extend at least 1 in. beyond the finished surface until the mortar is entirely dry, when the projection may be reduced to ⅛ in. Tubes of such approved make may be laid side by side when imbedded in plaster or otherwise.

At all outlets to and from cut-outs, switches, fixtures, etc., wires must be separated from gas-pipes or parts of the building by porcelain, glass, or other non-inflammable insulating tubing. Wires must not in any case be taped or otherwise fastened to gas-piping. If no gaspipes are installed at the outlets, an approved substantial support must be provided for the fixtures.

Wires of the same polarity, but belonging to different circuits, or leading to or from a double-pole switch, must not run in one groove through the same tube, nor in the same slot in a cleat.

In buildings specially liable to moisture, all wires (except those used for pendants) must be separated at least 6 ins., and supported by glass or porcelain insulators, by rubber hooks, or an approved tubing.

In crossing any metal pipes, or any other conductor, wires must be separated at least ½ in. from the same by a block of wood or other non-conductor, and so arranged that they cannot come in contact with each other by accident. Wires should go *over* water pipes where possible. When wires pass through walls, etc., in-doors, glass tubing, "floor insulators," or other approved tubing must be used. Wires of the same polarity, but belonging to different circuits, or leading to and from a double-pole switch, must not run in one groove, through the same tube, nor in the same slot in a cleat. Cleats should be made of well-seasoned hard wood (filled to prevent the absorption of moisture), porcelain or other approved material, and so made as to separate the wire at least ¼ in. from the building. When secured by cleats not over 4 ft. apart and tightly stretched, wires having a difference of potential of 120 volts or less, and carrying not over 10 ampères, should be separated at least 1¼ ins.; when they are confined in molding, a half-inch space is sufficient. Mains carrying currents of larger volume should be separated a greater distance. The use of metal staples for securing wire will not be approved.

All splices in wires must be soldered with a soldering bolt, if possible, and care must be taken not to render the wire brittle by overheating. The insulation of any joint must be equal to that of other parts of the same wire.

SAFETY CUT-OUTS AND SWITCHES.

Each installation must be equipped with double-pole safety cut-outs, that will interrupt the passage of a current in excess of the amount which any portion of the apparatus is adequate to transmit. A cut-out must be placed where the underground or overhead service joins the inside wires, and at every point where a change is made in the size of the wire (unless the cut-out in the larger wire is intended to protect the smaller). The plug or other device for inclosing or supporting the fusible strip or wire should be incombustible and moisture-proof, and so constructed that an arc cannot be maintained across its terminals by the fusing of the metal. No lead or composition strips carrying more than 10 ampères before melting shall be used, unless provided with contact surfaces of some harder metal having perfect electrical connection with the fusible part of the strip. There shall be a cut-out to each pendant and fixture.

All switches, except those in lamp sockets, should be double-pole. They must have a firm and secure contact that will make and break readily, and that will not stick between "full on" and "off," nor get out of repair easily in other ways. The points of contact must not be allowed to scrape, or rub, the entire surface of an insulating material between the contact strips; an air space must intervene. The carrying capacity of the different parts must be sufficient to prevent heating.

FIXTURE WORK.

Where wires are concealed within, or attached to fixtures, the latter must be insulated from the gas pipe by some approved device. All wire used for fixture work must have a good insulation; and must not, in any case, be smaller than No. 19 "B. & S.," or No. 20 "B W. G." Each fixture must be tested for possible "contact" between wire and fixture, and for "short circuit," before current is turned on. The tendency to condensation within the pipes or fixtures should be guarded against by sealing the upper end. No combination fixture with less than ¼-in. clear space between the inside pipe and the outside casing will be approved.

PENDANTS AND SOCKETS.

Cord pendants must be composed of standard wire, and protected by rubber bushings, or something equally good, where they enter the socket. Care must be taken to keep moisture from the inside of sockets.

The weight of every socket and lamp suspended by a cord must be borne by a ceiling block, rosette, or cleat, and by a knot under the bushing in the socket, in order to take all strain from the joints and binding screws.

SECONDARY GENERATORS OR CONVERTERS.

Converters must not be placed inside of any building except central stations, and should be inclosed in a metallic or non-combustible case. They may be placed on the outer walls when in plain sight and easy of access, but must be thoroughly insulated from them. If placed on wooden walls, or the wood-work of stone or brick buildings, the insulation must be fire-proof. When an under ground service is used, the converter may be put in any convenient place that is dry and does not open into the interior of the building.

Safety fuses must be placed at the junction of all feeders and mains, and at the junction of mains and branches when necessary; also in both the primary and secondary wires of the converter, in such manner as not to be affected by the heating of the coils. Secondary wires, after leaving the converter, will be subject to rules already given for inside wiring for incandescent lighting. The secondary circuit may be provided with a film cut out which connects to the earth outside of the building; but permanently grounding the secondary circuit is unsafe and will not be sanctioned.

MISCELLANEOUS.

All electric wires shall enter the premises at one point, preferably near the headquarters of the night watchman, where they can be kept under supervision; each of said wires shall be guarded by a protector against strong currents, operating by opening the circuit, and by lightning-arrester.

Such protectors against strong currents shall be located in a dry, accessible place inside the building, and as near the point of entrance of wires as possible, and shall be without ground connection; such protectors shall be mounted on non-combustible and insulated supports, which shall be provided with a receptacle for the burning or melted parts of such apparatus.

The lightning-arresters on all wires must be placed between the protector against strong currents and the electrical portion of the apparatus within the building to which such wires are connected. No ground wires for such lightning-arrester shall be attached to gas-pipes within the premises of the insured.

If any wires carrying high tension or strong currents are to be carried over or under other wires on the property of the insured, they shall be attached to poles so near to each other, with one wire so far above the other that if a break should occur the pendant wire between these poles may not be long enough to come in contact with the wire below; or, if not carried on poles, these wires shall be so placed or protected with guard wires as to render a contact between different wires impossible.

The Cheapest Railway in the World.

From a paper entitled, "The Cheapest Railway in the World," read at the Cresson Convention of the Am. Soc. C. E. by Mr. ARTHUR PEW, we make the following abstract of close financiering and cheap constructing which may be justly claimed, perhaps, to be without a parallel:

In 1884 the Dublin & Wrightsville R. R. was incorporated to build a railway between the two Georgia villages named in its title. The distance between the places was about 19 miles, and the sum of $22,600 was subscribed for the construction. Only 75 per cent. of this amount would certainly be paid in, but Mr. W. B. THOMAS, the President and Superintendent, hoped to raise the full sum by subsequent subscriptions. The right of way was given free of cost in nearly every case by the adjoining property holders.

The lack of money necessitated an extremely economical construction. The character of the line as built is as follows:

About 1.25 miles from Wrightsville, the road crosses a ridge through a gap, 20 ft. higher than the starting point, and then descends 76 ft. in the next 1.5 miles until the valley of the Ohoopee River is reached. From this point it gradually ascends for 2 miles the side of a hill until it has risen 87 ft., and is then on a smooth ridge along which it runs for a mile when the summit is reached. From here it gradually descends for 3 miles, and then, after a mile of more rapid fall, it crosses Bruton Creek, 138 ft. below the summit mentioned. The line follows the creek for 1.5 miles, maintaining the same level, until it crosses a small creek, along which it runs for 1.25 miles, ascending 88 ft. in this distance. Within the next 1.5 miles it descends 73 ft., and is then on comparatively level ground until the descent to the Oconee River is begun. The station in this valley is 186 ft. below the summit.

In the 17.6 miles located by Mr. PEW, there are 10.8 miles of tangents and 6.8 miles of curves; 6 miles of the curves have deflection angles varying from 30′ to 4° per station, and 0.8 of a mile is 4° 30′ 5° and 6°

curves, the latter being the sharpest used. There are no reversed curves, and the shortest tangent is 140 ft. The shortest curve is 353 ft. long, with a central angle of 7° 04'. The longest curve is 4,000 ft. n length, with a central angle of 71° 30'. The average length of the curves is 1,178 ft., and the average central angle 37° 20'. The ruling gradeis 1.5 per cent. on tangents, with compensation for curvature.

After the location was finished, a gang of 40 convicts, at $1 per day each, began the grading. The greater part of the line was through a forest of excellent pine timber which supplied the wood for ties and trestles. A width of road just sufficient for the grading was first opened for a distance of several miles, and then the men returned and cleared the whole right of way. The roadway was 14 ft. wide on cuts and 10 ft. on fills, the cost of the grading being 9 cts. per cu. yd. The cross-ties cost 9 or 10 cts. each and were laid every 2 ft. The grading averaged something less than 4,000 cu. yds. per mile.

The trestles and ties were all made by convicts under the direction of skilled foremen at less than a half the usual price.

The first annual report of the President showed that 11.5 miles of road was completed and in operation. The track was standard gauge, laid with a 45-lb. iron rail and fastened with fish plates. The total cost of preparing the road bed for the rails was $13,392, $700 of which was for the right of way, $1,134 for engineering, $11,558 for grading, cross-ties and trestles. The cost per mile, then, was $1,165. The iron rails were furnished and laid $1,800 a mile by the Georgia Central R. R., of which line the D. & W. was a feeder. The extension of the road from the level plain mentioned above to the Oconee River was the most expensive part of the line, costing more than five times as much per mile as the remainder of the road.

In the second annual report of the President, it was shown that the completed road, ready for the rolling stock, had cost $3,441 per mile, or $65,381 in all.

The character of the business was such that nearly all of the freight was received and shipped in foreign cars, and $1,000 per mile would have paid for the necessary rolling stock had any been needed. Fortunately, the Dublin & Wrightsville R. R. is simply an extension of the Wrightsville & Tennille R. R., which possessed a rolling stock sufficiently large to handle the traffic of both lines. A contract was soon formed by which the trains of the latter railroad were to run over both lines, 35 miles in all, and the expenses of running them were to be divided.

The actual cost, then, of this railway with its road in operation, was only $3,441 per mile. The earnings have always exceeded the expenses and from the surplus the roadway has been widened, objectionable grades and curves improved, new stations built, 20 miles of new steel rails laid, cars and engines purchased, and annual dividends of 6⅜ per cent. paid.

The Giffard Liquid-Gas Gun.

We reproduce from the *Revue Industrielle* the accompanying drawings of the Giffard gun which has lately been attracting so much attention, largely perhaps on account of the high reputation of the inventor, and the great value which he attaches to the invention. M. GIFFARD is best known to the world as the inventor of the Giffard injector, but his inventions are almost numberless, and many of them highly meritorious. He has publicly claimed himself that this gun is destined to revolutionize warfare, and to make war almost impossible. The one grave defect of the gun, however, seems to be lack of adequate range.

In principle the gun is simplicity itself. Carbonic anhydride (CO_2) liquifies at 36 atmospheres or some 540 lbs. per sq. in., and is the explosive so far used. A steel cylinder 9 ins. long shown in detail in Fig. 3 and in place in Fig. 1, contains enough liquid for 150 shots. The reservoir is easily detachable, as will be seen, and as nearly as we can judge from the imperfect description, the impact of the hammer drives back the piston closing the chamber against the pressure of the gas and of a spring far enough to permit a small part of the fluid to escape; the chamber then instantly closing in spite of the resistance of the trigger spring. The conical ball, as nearly as we can judge, is inserted vertically at *A*, Fig. 1, the round plug in which it rests being then revolved through 90°, making the hole through the plug, with the shot in it, a part of the barrel. The gun is a very much cheaper one than those for powder, and firing it, of course, produces intense cold instead of heat, with no tendency to fouling. On the other hand, the work done in expelling the ball through the rifled barrel will produce no little heat, so that the piece may maintain a sufficiently equable temperature.

The gun is very cheap, and there is, of course, no smoke. There is also very little noise; it is compared to the popping of a soda-water bottle. *Industries* states that some Birmingham firms have offered to manufacture them for $4.86 each, and have been

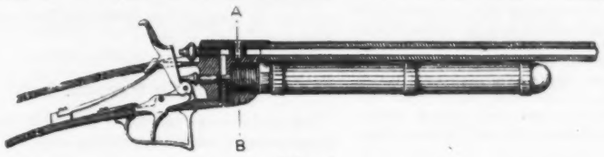


FIG. 1.

FIG. 2.

underbid by a Belgian firm. The cost of the "explosive" is said to be only one cent for 50 shots. The entire weight of the arm is only 4½ lbs., the charging chamber weighing 9 oz. charged.

The one difficulty which seems to be fatal is lack of sufficient range; 540 lbs. per sq. in. is a very low initial pressure, most modern rifles having 30,000 to 35,000 lbs. The range would not be reduced in the proportion of these pressures, of course, nor in anything like it, but it is difficult to see how its effective range could be much, if any, over half a mile. Something might be gained in this respect, should the principle of the gun be established as successful, by using a gas which requires a higher pressure to liquefy.

Another difficulty which occurs to us in the gun as now designed is that the muzzle must be elevated above the horizontal or there is danger that no fluid at all will escape from the chamber, but merely gas. Unless the fluid entirely covers the aperture, it is obvious that no fluid at all is likely to escape, for gas escapes from an orifice at so much greater velocity than a liquid that it would entirely fill the small space left for the liquid, and create a back pressure against it, before any had escaped. Ordinarily, the muzzle is slightly elevated, but should it chance to

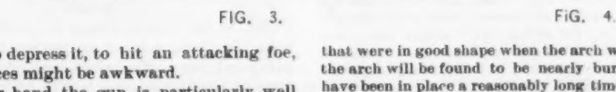


FIG. 3.

FIG. 4.

be necessary to depress it, to hit an attacking foe, the consequences might be awkward.

On the other hand, the gun is particularly well adapted for development into a machine gun, for obvious reasons, and such a gun, even if of short range, might well do terrible execution. On the whole, the next great war, if it holds off long enough, is likely to bring out some remarkable developments in the art of scientific slaughter.

Brick Arches in Locomotive Fire-Boxes.

The following is the substance of the report of the committee of the American Railway Master Mechanics' Association on "brick arches in locomotive fire-boxes; their efficiency in consuming the various gases composing black smoke; saving of fuel when used in connection with extension front, and as compared with diamond stack; first cost and cost of maintenance," as presented at the late Old Point Comfort Convention. It will have especial interest in view of the comments of *The Engineer* on American use of brick arches, which we republished and discussed in our issue of Aug. 2.

A circular was addressed to members calling for information on the subject of brick arches, to which 31 replies were received, showing that 24 used the arch, 1 of whom used circulating pipes and 10 used stud angle iron, or a combination of both, to support it, and 7 did not use the brick arch in any form; 3 of the latter used anthracite coal for fuel, 1 used wood, 1 had tried the arch and discarded it—no reason given; the remaining 2 had never used it.

Your committee find it is the unanimous opinion of all those who use bituminous coal and brick arch, that it is most efficient in consuming the various gases composing black smoke, and by impeding and delaying their passage through the tubes, and mingling and subjecting them to the heat of the furnace, greatly lessens the volume ejected, and intensifies combustion, and does not in the least check but rather augments draught, with the consequent saving of fuel and increased steaming capacity that might be expected from such results; this in particular when used in connection with extension front.

The statements of several experienced members based upon actual tests extending through long periods, also show most conclusively that the brick arch may be used with short front and diamond stack, with excellent results and great economy, when bituminous coal is used as fuel, while but very few replies to our circular give positive data, from which even an average per cent. of the saving of fuel could be shown. There remains no room for doubt as to the economy of a properly arranged brick arch in a locomotive fire-box, using bituminous coal as fuel. Some of the replies say the saving is from 25 to 40 per cent. This assertion is backed by the unanimous opinions of all those using them. The same can be said of its efficiency in decreasing the number of live sparks thrown from stack.

Your committee has positive proof that the claims for fire along many roads, who formerly used no arch, have been greatly lessened by the use of the arch, even without the extension front, and, when used in connection with the extension front, the throwing of dangerous live sparks was almost entirely avoided, as long as everything was kept in good shape. In addition to the great advantage already mentioned, your committee ascertained the fact beyond dispute that the arch in connection with a well arranged extension front greatly lessens the throwing of fine cinders and dirt from the stack on the train, thus prolonging the life of car roofs, varnish, paint, etc. Especially is this apparent on passenger trains, and it of course adds greatly to the comfort of passengers.

Your committee fails to find in the large correspondence it has held with practical men who are using the arch, any evidence that one well constructed and properly applied has any seriously damaging effect on the sheets of the fire-box or boiler tubes, but, on the contrary, much evidence is shown that the tubes are greatly protected at fire-box ends, and do not cut away or clog up as fast as when no arch is used, and that, as a rule, when an arch has to be removed to clean out or work upon flues that were in good shape when the arch was applied, that the arch will be found to be nearly burned out, and to have been in place a reasonably long time, and probably saved many times the cost of its removal and renewing.

The average brick arch supported on circulating pipes costs about $30 in place in fire-box; in some cases more, in others less; the cost varying with the mode of application, number and thickness of tubing, etc. The addition of extension front averages about $100. The items of stack and cast front end proper, with door, are not included in cost of arch and extension as given here, as these would have to be used under any circumstances. Your committee finds that the arch complete on circulating pipes is applied by some roads for from $17 to $20, while others who are equally as well equipped to do the work say it costs them from $35 to $45. We also find the same difference in cost of applying extension front in various shops; some roads claiming to apply it for $60, while others say it costs them $150, not including stack and front proper and door. We find the greatest difference in cost of applying arch exists on roads using devices other than circulating pipes to support arch. One road puts in arch complete for $4, another for $5, while some using almost the same arrangement place the cost for complete arch at $20.

The information gathered by your committee shows conclusively that the first cost of arch, supported on circulating pipes in a safe and substantial manner, is about twice that of most of those supported by angle irons, protected studs, etc., and if we can be safely guided by the written statements of some of our most intelligent and practical master mechanics, these latter devices, if properly protected by allowing the bricks to cover the supports, last longer than the best applications of the former, and of course the danger attending a bursting pipe is dispensed with. Your committee finds it very difficult to decide from any data furnished them by members of the Association, or from any other source, "The best

manner of supporting the arch." Those using circulating pipes claim it as best, and say they have in most cases tried other plans and gone back to the pipes. Others who formerly used pipes have abandoned them for angle iron, and still others with studs protected by a pipe drilled to shield them, and the whole somewhat covered by the brick arch

There are many points in favor of abandoning the circulating pipes if other satisfactory supports can be arranged. First, the circulating pipe support is attended with more danger from their liability to become clogged or burning thin and bursting, or from blowing out of sheets and scalding firemen or others, even where rigid inspection is made at regular periods. Second, the pipes are more costly to apply and difficult to adjust to position, and in order to secure a safe and tight fit, great care must be taken in cutting and tapping holes and threading pipe, sleeve nut, etc., and in the few instances where arch pipes are put in and expanded in position, thinner tubes must be used and very large holes bored in the sheets opposite ends of tubes, all of which are somewhat objectionable. Third, the pipes are generally more or less in the way of working on boiler tubes, particularly where more than three pipes are used, and if only three pipes are used, broken bricks cannot be utilized, which is one of the best features of the pipe support.

The good points of the pipe support must not be overlooked, however, and among them may be mentioned: First. As a rule, a simpler, and consequently cheaper, style of brick can be used. Second, If four pipes are used, nearly all broken bricks can be utilized, and to those familiar with the shipment of car load lots of ordinary arch bricks, this is a big item. Third, If, as claimed by many, that the brick injures the side sheets when allowed to rest close and hard against it, as is generally the case in most other methods of supporting it, the pipes will admit of a suitable space being left at ends of bricks without impairing the rigidity of their support. Fourth, When shops are well equipped and have good system, the circulating pipe support can be put in for much less than it is costing most of our roads at present.

Your committee finds that the first cost of applying brick arch and extension front to new locomotives while building can be done in the best manner for about $130 over cost of short front, diamond stack and plain fire-box, and possibly for less than this, while it will cost about the same money to convert an old short front and plain fire-box into brick arch, extension front and straight stack; but as the old engine should have some credit for difference in cost of diamond stack, if in fair order, as compared with cheap straight stack (a good cast-iron stack of latter type can be made and fitted to smoke-box and bolted in place with saddle complete for $14), it can be done for less than $130 per engine, if properly handled.

Your committee finds it is the almost unanimous experience of all those using the brick arch and extension front that its cost of maintenance is much less than the cost of keeping fire-tight and spark-proof any form of diamond stack, or other stack, or spark arrester, with cone and netting and lining exposed directly to the action of coal sparks driven by exhaust, the cutting effect of which is almost as severe as the "sand blast," and causes constant and frequent renewals to all exposed parts, while the comparatively gentle suction of the high nozzle of the extension is ample to clear the tubes and deposit the sparks in the front, but does not cut away the heavy steel wire netting below the nozzles. The sparks in the one instance are caught and driven before the exhaust steam and along with it, while in the other they are sucked or pulled after the successive exhausts, and the sand blast effect is destroyed.

The data gathered by your committee fail to show any comparative figures of cost of maintaining the two styles of fronts, but the evidence is overwhelmingly in favor of the brick arch and extension front (outside of first cost), and there seems to be no doubt on the part of nearly every one using the arch and extension that after an engine has been properly equipped with both, that they can be kept much nearer fire-tight at a greatly reduced cost over the diamond stack and short front; in fact, where the extension is properly applied and kept absolutely air-tight below the line of spark accumulation, and a proper adjustment of baffle plates, netting, etc., made and kept, and sparks regularly blown out, they frequently ran from one tire-turning to another without any cost of renewing parts, and in many cases instances are shown where plates, nettings and other parts are run in constant service for several years, and where cast iron stack is used it only has to be renewed in case of accident.

Your committee desire to call attention to the exhaustive report on "Extension fronts and brick, and other fire-box arches," to be found in report of our Convention of 1888, of which Mr. JOHN HICKEY was chairman, and which so fully covers both sides of the subject, especially the efficiency and economy of the brick arch and extension front, in connection with bituminous coal fuel.

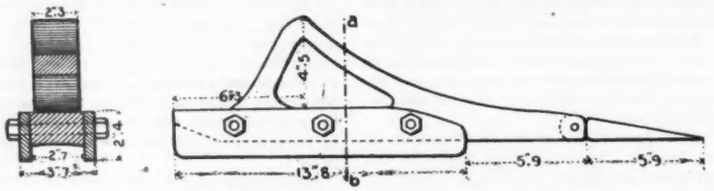
Your committee find that the brick arch greatly assists in bringing about more perfect combustion, and thus aids in lessening the amount of black smoke formed, and, for the reasons already set forth, helps to consume, or rather burn out, the combustible parts of the gases composing the smoke that is formed. We fail to find that any serious damage results from their use, and the first cost and cost of maintenance, as compared with ordinary "diamond" stack, plain fire box and short front, is plainly in favor of the former. We therefore recommend its use by all who desire to get the best and most economical results from bituminous coal fuel.

Before closing this report, we desire to call attention to the large number of arch bricks broken in transit and by handling after they are received. This is especially the case where bricks are hauled long distances and when shapes are flat, long and heavy. It has occurred to us that some suitable means might be adopted to strengthen the brick by having iron rods made up in the moulds in such manner that should the bricks become cracked or broken through their section they would be held together and could be utilized, and as soon as exposed to heat in furnace they would fuse together from the effect of accumulated slag, etc.

T. W. GENTRY, ALLEN COOKE, L. C. NOBLE, W. A. SMITH, } Committee.

Chock for Stopping Cars.

For about a year and a half the chock for stopping cars shown in the accompanying cuts, for which we are indebted to the *Centralblatt der Bauverwaltung*, has been used with much success in the yards of the Cologne-Gereon station in Germany. It has been the custom there to switch the cars from the stations down an incline of 2 per cent. about 200 ft. in length, from the bottom of which they are switched off upon the proper tracks. The chocks are placed from 45 to 90 ft. in advance of the place



CHOCK FOR STOPPING CARS.

where the cars are to stop. They are made of wrought iron with a hinged steel point. The old shoes made in a solid piece would curl up from the point after some use, and it was found necessary to adopt the moveable point which always lies close to the head of the rail. The device may prove useful to some of our American roads. The chock is simply laid upon the rails loose, but never slips nor becomes displaced.

Reports of State Railroad Commissions.

MAINE.

The Maine report comes to us this year neatly bound in cloth, a great improvement over its old pamphlet form. The chief technical work of note done by the Commission was in collecting statistics of the progress of car heating and investigating two serious accidents which occurred during the year. The returns showed that in June, 1889, out of 659 passenger cars in use in the State, 164 were heated by steam from the locomotive. Of the 187 mail and baggage cars in use, 42 have steam from the locomotive, 75 have hot water heaters, and 4 have the Spear stove. This seems to be about the only one of the modern reforms which is making much progress. The Commission shows its broad knowledge of the question of automatic couplers when it says:

While satisfactory progress is being made in the operation of railroads and trains in most respects, little, if any, is being made in the methods of coupling freight cars in this or other States. . . . The action taken by the Master Car Builders' Association in the adoption of the "Janney type" of coupler has, we believe, tended more to hinder than to promote the general adoption and use of automatic couplers.

The most important event in the year covered by the report was the completion of the Canadian Pacific extension, 145 miles in length, in the northern part of the State.

MASSACHUSETTS.

The report opens with some very good matter on car heating, ventilation, freight train brakes and freight car couplers, bridges, roadway, stations, grade crossings, etc. Concerning the first topic the Board states its position as follows: "Although many improvements are desirable, locomotive steam heating in its present development is a success." The Board believes that the system has such inherent merit that it will come gradually into general use without compulsory legislation.

A page and a half is devoted to ventilation; and it is said that much more life has been destroyed by poorly ventilated cars than by the car stove. The solution of this problem should be made at the same time that steam heating from the locomotive is introduced.

On the brake and coupler question the Commission, as in previous years, takes advanced ground. Congressional action to promote the adoption of automatic couplers and continuous brakes is recommended, and the board does not seem to have much faith that the reform will be brought about without it. Their observations on this point have evidently been most accurate as regards roads in their immediate vicinity.

The annual report on the railway bridges in the State, prepared by Prof. GEO. F. SWAIN, is an excellent and interesting one. Special attention is called to the recommendations of a previous report that the numerous jackknife draws about Boston be guarded by rerailing devices. On the Fitchburg the rerailing devices on some of the bridges west of Greenfield have placed cars on the track three or four times during the past year and a half. One case cited was a truck derailed by a fallen brake beam, which was put back on the track at the Chickley River bridge. After crossing the bridge it became derailed again, ran a mile and half on the ties, and was put on the track again at the next bridge, where it stayed this time, the brake beam which caused the trouble having dropped off.

The work of inspection of the railway bridges in the State and examination of their strain sheets, etc., begun three years ago, has now been completed. Since the Bussey bridge disaster the railway companies of the State have been busily engaged in strengthening and renewing their bridges, having expended in the three years of 1887, 1888 and 1889 over four and one half million dollars for this purpose. There are now 1,673 railway bridge structures in the State, of which 872 are of iron, 168 of stone, and the remainder wooden and combination bridges.

The report notes a new bridge with solid floor, covered with ballast, on the Providence & Worcester road as "the only example of this construction in the State, and probably in New England." The New York, Providence & Boston has some bridges of this type, but with this exception the statement is doubtless correct.

Under "roadway" it is stated that the most progressive roads are continually extending the electric distance block system. "The time-block system in all its various forms, inasmuch as it is dependent for its safe operation upon the faithfulness and the infallibility of station agents, is in accuracy and certainty inferior to the electric distance block system as now developed." The fact is also touched upon that the antiquated ball system of signals is still in use at points where safety demands the use of interlocking systems.

Concerning facing-point switches, the report declares that "strenuous need can alone justify their existence. Over a hundred facing points on the Boston & Albany main line have been dispensed with during the past five years." In view of the number and fatality of accidents resulting to trains split at a switch this advice is most pertinent.

Diversity of practice with regard to signals is said to be still so bad that the arrangement of lanterns which means safety on one line means danger on another; a sort of recklessness for which it seems hard to invent an excuse. The Board urgently recommends the adoption (and *enforcement*) of the General Time Convention's standard code.

The excellent monograph in last year's report by Prof. A. GOERING, of Berlin, seems to have had no effect as yet in improving the station arrangements

in the vicinity of Boston. The fact is that at many points near Boston the business has outgrown the capacity to safely handle it unless better safeguards are provided. The Board recommends fences between the tracks to prevent crossing from one side to the other, and subways or overhead bridges for crossing.

The subject of grade crossings is still a live one, and according to statistics bids fair to be for some time. There are now 2,218 highway grade crossings in the State. During the past year 13 have been abolished and 17 more were created on the Grafton & Upton road by special act of the legislature. At this rate of decrease it will be some time before a complete separation of grades is brought about. There were 30 fatal accidents at grade crossings during the year. To ameliorate the dangers the Board recommends: 1. Changing location of highways where needed to make the crossings at right angles (not always an easy task). 2. Removing trees, bushes and banks which may obstruct the view. 3. Requiring gates or a flagman at all crossings where trains pass at speed, and limiting speed of trains at all unprotected crossings. 4. Making it a misdemeanor to pass onto the tracks when gates are down or the flagman gives warning.

The subject of insufficient brake power on passenger trains was forcibly brought to the attention of the Board by the accident near Springfield to the New York and Boston express, on April 26, 1889. The train ran a little over a mile with the brakes applied and then ran into the rear of a freight train at a speed of about 6 miles per hour. The investigation showed that only 57% of the train weight was effective in braking, while by applying brakes to the engine drivers and to the center wheels on 6-wheeled trucks 77% of the total train weight might have been utilized for braking. The Board urge the general use of driving-wheel brakes and of brakes on every wheel of 6-wheel trucks.

The subject of electric street railways is discussed at some length. On Sept. 30, 1889, there were 50.5 miles of electric railway in the State, of which 28 miles belonged to the West End Street Ry., of Boston. Thirty-eight miles more were under construction, besides a storage battery line 3 miles in length between Danvers and Beverly. Attention is called to the fact that the high speed of electric cars and the fact that no horses are in front of them makes necessary the provision of a more efficient type of fender. Those now in use on the West End cars, say the Board, will, in case of accident, act as instruments of mutilation rather than as a means of safety.

RHODE ISLAND.

This State has a single commissioner, and in view of the fact that the total extent of the railways within her borders is but 236 miles, she is more excusable than some other States which continue to rely on the "single-head" commission. The technical matter in the report is excellent. Grade crossings, steam car heating and automatic freight couplers and air brakes, as the leading pending reforms of the day, are taken up first. Other matters discussed are the new terminal facilities for Providence, care of roadbed, bridges and stations, and tell-tales or bridge guards.

Concerning these last, which, as is well known, are intended to warn freight brakemen of the approach to a low bridge, it is stated that their framework is frequently so low that they are only less dangerous than the bridges themselves.

Under street railways the report describes the line of the Providence Cable Tramway Co., which was opened for business Jan. 1, 1890, and is the first cable street railway to be built in New England.

NEW YORK.

The report opens with a general statement of the railway situation from an economic standpoint, discussing the Interstate Railway Association (a body which can hardly be said to have had much to do with New York's railway traffic) and the Interstate Commerce law. The latter is declared to have been of great benefit to the railways and the community

The accident record shows a total of 589 persons killed and 1,105 persons injured during the year. Of the injuries 366 were received in coupling or uncoupling cars, and 355 of the deaths were due to "walking or being on the track." Collisions caused 24 deaths and 80 injuries during the year. The seven passengers who lost their lives from circumstances beyond their own control during the year were all killed in rear collisions.

The Board alludes to the fact that falling from engines or cars causes even more deaths to employés than coupling cars, and renews its recommendation that a low railing be placed on the sides of freight car roofs. Continuous brakes are referred to as a still better remedy, however. No less than 12 employes were killed and nine were injured by catching their feet in frogs or between rails. Blocking, which has been heretofore recommended to avoid this danger is said to be worse than useless, which is a little difficult to believe if the work is properly done.

Heating cars from the locomotive is now an accomplished fact in the State of New York, says the Board, and the system works fairly well only, "because the temperature of the steam is so high and the pipes get hot so quickly if the valves are much opened that the utmost care is necessary on the part of trainmen to keep an even or comfortable temperature."

The other matter contained in the report—the accounts of accident investigations; inspection of roadway; treatment of complaints presented; criticism of bills before the Legislature; applications for change of motive power on street lines; increase of capital stock, issue of bonds, etc.—prove that the Commission and those in its employ must have had little time for idleness during the year.

Legal Decisions of Interest to Engineers.

Compensation by Railway Company for Injury to Abutting Property. The use of a street by a railroad company for its track, under legislative or municipal authority, when it interferes with the rights of adjoining lot owners to the use of the street, subjects the company to an action for damages on account of the diminution of the value of the property caused by such use. (Hot Springs Ry. Co. v. Williamson, Supreme Court of the United States, 10 Sup. Ct. Rep , 955.)

Extra Compensation for Grading Streets.—A contractor took a contract to grade a street, no provision being made in the contract for extra filling, and though the specifications provided for such filling, the contractor cannot recover for the filling furnished. When there was a large quantity of soil upon a street which might have been used for filling and subsequently to the letting of the contract trespassers removed it, the city is not liable to the contractor for the soil thus removed (Palladino v. Mayor of the City of New York, Supreme Court of New York, 10 N. Y. Sup., 66.)

Implied Promise to Pay for Work upon a Public Street.—The plaintiff sued to recover for certain work done upon the public street under a parol contract. It appeared that the defendant filed a protest against the issuance of the permit to do the work, and informed the plaintiff's assignor that the defendant would not be responsible for the work. The defendant cannot be compelled to pay for the work. (Nagle v. McMurry, Supreme Court of California, 24 Pac. Rep., 107.)

Watchman at Railway Crossings.—When a city ordinance requires the presence at a railway crossing of a watchman "who shall display at the cars in the day time a red flag," it is not sufficient if a watchman is present with a flag at the crossing, but he must also warn passers by of the danger from approaching trains. (Wilkins v. St. Louis, I. M. & S. Ry. Co., Supreme Court of Missouri, 13 S. W. Rep. 893.)

Failure to Fence Railways—Stock Killing.—The fact that a railway company fails to fence its tracks, and by reason of such failure stock gets upon the track and is killed, is sufficient proof of the company's negligence under the Michigan statute to warrant a recovery against it. (Talbot v. Minneapolis, St. P. & S. S. M. Ry. Co., Supreme Court of Michigan, 45 N. W. Rep., 1,113.)

Negligence at Public Crossings.—Where a person crossing a much used railroad crossing, consisting of several tracks, observes and keeps out of the way of two trains, but is killed by a third engine which he did not see, though he might have seen it in the exercise of care and discretion, the company will yet be liable for his death if it appears that if in the exercise of due care and caution those operating the engine might have seen him and warned him of his danger. (Hilz v. Missouri Pacific Ry. Co., Supreme Court of Missouri, 13 S. W. Rep., 946.)

Brakeman Injured while Coupling Cars.—There being evidence that a brakeman went between cars when still, to uncouple. While uncoupling, the train moved and, owing to a defective bumper, his arm was crushed. It was several months before he could work again, and then he was not able to earn the same wages as before the injury. A new trial will not be granted, the judgment below being in favor of the complainant. (Georgia Pac. Ry. Co. v. Weaver, Supreme Court of Georgia, 11 S. E. Rep., 614.)

Sufficiency of Evidence of Masters' Neligence.—Plaintiff sought to recover for injuries received while working on a ditching machine built upon a flat car. Mere surmise and conjecture that the negligence of the defendant company was the proximate cause of the injury is insufficient. That there was a breach of neglect of legal duty by the defendant company must be shown by competent evidence, and that such neglect was the proximate cause of the injury. (Larsonov. v. St. Paul & D. Ry. Co., Supreme Court, Minnesota, 45 N. W. Rep., 1,096).

Employé of Railway Company Injured While Signaling Train.—The tracks of two railways came close together in a certain freight yard, and it was the custom of the employés of one of the roads to step upon the track of the other road to make signals, the signals being made for the protection of the property of both roads. While standing on the tracks of the defendant company signaling, the plaintiff's decedent was killed by a switch engine of the defendant company. The evidence showed that those in charge of the switch engine did not "look out" to see if any one was on the track. The plaintiff's decedent was not a trespasser nor guilty of such contributory negligence as would preclude a recovery against the company. (McMarshall v. Chicago, R. I. & P. Ry. Co., Supreme Court of Iowa, 45 N. W. Rep., 1,065.)

PERSONALS.

Mr. I. Y. SAGE, General Superintendent of the Georgia Pacific R. R., has resigned.

Mr. W. E. DEVINE has been appointed General Superintendent of the Rio Grande Southern Ry.

Mr. KENNETH ALLEN, M. Am. Soc. C. E., is preparing plans for the sewerage of Fort Supply, Ind. T.

Mr. T. H. Riley has been appointed Assistant General Superintendent of the St. Louis, Kansas City & Colorado R. R., in charge of track and transportation.

Mr. JAMES DUNN, for many years Chief Engineer of the St. Louis & San Francisco Ry., has been appointed Chief Engineer of the Atchison, Topeka & Santa Fé R. R.

Mr. D. P. FORD has been appointed Chief Engineer of the Long Island R. R. He will have charge of the bridges and track as well as the surveys and constructions.

Mr. W. S. PAGE has been appointed Assistant General Superintendent of the Chicago, Rock Island & Pacific Ry. lines west of the Missouri River with headquarters at Topeka.

Mr. W. H. V. ROSING has been appointed Assistant Master Mechanic of the Chicago and Pontiac Division of the Illinois Central R. R., with office at Chicago. He was formerly Chief Draughtsman of the road.

Mr. OSCAR SANNE, C. E., has been appointed Consulting Engineer for the steel construction in the Pfister Hotel, costing $400,000, now building at Milwaukee, Wis. The architects are H. C. Koch & Co.

Mr. CHARLES MEHLER, of Louisville, Ky., has been appointed Senior Assistant City Engineer by City Engineer SCOWDEN. Mr. MILLER has been connected with the city engineering department for the past twelve years.

Mr. ARTHUR PEW, M. Am. Soc. C. E., of Talbotton, Ga., has changed the spelling of his name from its former form of ARTHUR POU, in order that the spelling of the name might more closely correspond with its proper pronunciation.

Mr. CHAS. P. TREAT, contractor for the first ten miles of railway for the Nicaragua Canal, has returned to this country, all the difficult part of this work being now completed, and does not expect to return to Nicaragua unless he should take some further contract for the construction of the canal work proper. He reports the work as progressing very satisfactorily, and the project, as a whole, entirely feasible.

NEW PUBLICATIONS.

REPORTS.

—Rules for the Installation of Electric Lighting and Motive Apparatus. Jointly adopted by the Boston Manufacturers' Mutual Fire Insurance Co., the Boston Fire Underwriters' Union, and the Electric Mutual Insurance Co. Pamphlet, 9 pp., abstracted elsewhere.

TRADE PUBLICATIONS.

—Descriptive Price List of Photo-Printing Papers and Materials. KEUFFEL & ESSER CO., New York, pp. 6.

This little leaflet contains some useful points on the printing and kindred processes.

Catalogue of the Iron Cottage Co., Manufacturers of Portable Houses. Grand Rapids, Mich. Pamp. pp. 8.

The construction of these little portable houses, varying from 10 × 10 ft. to 15 × 22 or more, is becoming quite an important American industry. Those manufactured by this company are chiefly of iron, and certainly of excellent design. We shall make some extracts from this catalogue later.

SOCIETY PROCEEDINGS.

Engineers' Club, Minneapolis.—Secretary F. W. CAPPELEN writes us: I have the pleasure to inform you that the old Society of Civil Engineers of Minneapolis was disbanded and reorganized May 7, under the above name and officers, with 22 charter members. Through the kindness of the Board on Public Library, the club has permission to hold its meetings in the Public Library. The librarian of the Public Library, Mr. PUTMAN, has offered to subscribe for any technical periodical the club may desire, both American and foreign; will also buy any desirsirable work on engineering topics the club or individual members may ask for, and put them on file for general use in the library.

We have had two well-attended meeting under the new management. Papers were read on "Ventilation of Public School Buildings" and "Efflorescence on Brick." The club will make some experiments in regard to the two above mentioned subjects, and hopes to be able to publish these papers in an interesting and complete form this fall. At present everything points to a bright, active future,

ENGINEERING NEWS

AND

AMERICAN RAILWAY JOURNAL.

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Vol. XXIV. Saturday, August 9, 1890.

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CHAS. W. BAKER, E. E. R. TRATMAN, M. N. BAKER, F. P. BURT, } ASSOCIATE EDITORS
GEO. H. FROST.....BUSINESS MANAGER

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Advertising rates. 20 cents per line *agate measure. Schedule sent on request.* **Changes** *of advertisements must be in hand on Tuesday afternoon;* **New** *advertisements Wednesday afternoon;* **Transient** *advertisements not later than Thursday noon. The last pages go to press early on Friday, and we shall be obliged if subscribers who fail to receive their papers promptly will notify us without delay.*

Drawings and Photographs *of all new engineering works or designs, large or small, of interest from their magnitude, novelty, or originality, as well as newly adopted* **Standard Plans** *for engineering structures or details, rolling stock, etc., are always desired for early publication. Also* **Brief Technical Notes** *of the cost or manner of executing work, tests of materials, machines or other new devices, and* **News of New Construction** *of all kinds.* **Letters** *for publication must be accompanied by the name or card of the writer.*

COMING TECHNICAL MEETINGS.

Civil Engineers' Club of Cleveland.—Next meeting, Aug. 12. Secy., C. O. Palmer, 22 Cedar Ave.

Civil Engineers' Association of Kansas.—Next meeting, Aug. 18. Secy., J. C. Herring, Wichita, Kan.

Engineering Association of the Southwest.—Next meeting, Aug. 14. Secy., Olin H. Landreth, Vanderbilt University, Nashville, Tenn.

Engineers' Club of Philadelphia.—Next meeting, Aug. 16. Secy., Howard Murphy, 1122 Girard St.

Engineers' Society of Western Pennsylvania.—Next meeting, Aug. 19. Secy., S. M. Wickersham, Pittsburg, Pa.

Engineers' Club of Cincinnati.—Next meeting, Aug. 19. Secy., J. F. Wilson.

American Society of Civil Engineers.—Next meeting, Aug. 20. Secy. John Bogart, 127 E. 23d St., New York.

Engineers' Club of St. Louis.—Next meeting, Aug. 20. Secy., W. H. Bryan, 30 South 7th St.

New York Railway Club.—Next meeting, Aug. 21. Rooms, 118 Liberty St.

New England Roadmasters' Association.—Annual meeting, Aug. 21 and 22, Boston, Mass.

Western Society of Engineers.—Next meeting, Sept. 2. Secy., J. W. Weston, 280 La Salle St., Chicago.

Association of Civil Engineers of Dallas.—Next meeting, Sept. 5. Secy., E. K. Smoot, Elm and Austin Sts.

American Society of Railway Superintendents.—Annual meeting at New York on the day preceding the fall meeting of the General Time Convention. Secy., C. A. Hammond, 350 Atlantic Ave., Boston, Mass.

WE have again to suggest to a couple of our contemporaries that the only honest way is to give due credit in copying cuts or other matter from this journal. We find that *Industries*, of London, reprints almost entire the notes and editorial comments on the bids for the Diamond Shoals lighthouse in our issue of July 5, and gives not a word of credit. A sinner of smaller importance, but whose crime is much more reprehensible, is a sheet called *Fire and Water*, which reproduces our perspective view of the elevated reservoir at Ypsilanti, Mich., first shaving off the background of the cut, and with it the stamp "Eng. News" and the name of the artist. Our contemporaries have surely heard the proverb that "Honesty is the best policy;" and we have heard of cases where people were honest from motives higher than mere policy.

AN officer of the Complete Combustion Co. controlling the downward draft locomotive illustrated in our issue of Aug. 2 writes us to say that as the "drop leg" is connected with the fire-box space at the sides there is no possible need of any further provisions for ensuring free circulation. We trust this is so, but heretofore such water legs have given trouble in this respect. He appears to think we spoke of it as a pocket simply, suspended from the crown sheet, which the context should make it fairly clear that we did not, besides the evident absurdity of such construction. If built in that way, burning out or explosion would be apt to follow very speedily.

Our correspondent also claims that in speaking of the additional bending of the back made necessary by the greater height of the grate, we did not sufficiently allow for the fact that the fire-box door was also some 18 ins. higher than is common. Perhaps we did not sufficiently allow for this, but even doing so, there will still be more back-bending necessary. This is a minor question, however, and we readily admit, as we did in our article, that the principle of the device has much to commend it, and is one which it is well should be tested fully in practical service.

THE American Society of Mechanical Engineers continues its excellent "Employés' Bulletins," the last issue, for example (No. 6), containing the following announcement of vacancies:

No. 019. Vacancy for a locomotive and machine designer on a Western railway.

No. 020. Vacancy in a railway drawing room for a graduate of a technical college with some shop experience.

No. 037. Wanted, a good draughtsman up in the latest New England practice of economical manufacturing.

No. 038. First-class mechanic on fine work, and with some steam engine experience and executive ability.

No. 039. Superintendent of a manufactory with considerable executive ability and engineering talent. Salary, about $2,500.

No. 040. Vacancy for active, bright young man as mechanical draughtsman. Boiler shop experience required.

No. 041. Wanted, good mechanical draughtsman with good education, familiar with steam and hydraulic machinery.

Nos. 042 and 043. Vacancies in one house for an engineer with commercial experience to act as manager, and one to conduct correspondence in relation to a special line of machinery manufactured by the company. A person between 30 and 40 years of age is desired.

No. 043. Engineer wanted in reference to enlarging a plant for working a phosphate deposit and to replace hand work by mechanical appliance, and to advise also as to transmission of the phosphate from bed to point of shipment.

We have often commented on the great need of some established and recognized means of intercommunication between those having vacancies to fill and those anxious to fill them, if every man is to have a fair field and no favor. The best means in the end, in our opinion, is by notices in the columns of a weekly journal like our own. Experience seems to indicate this; but we welcome any attempt to provide such facilities through whatever channel, and trust the Am. Soc. M. E. will persevere in this effort to perform a most useful work effectively. It is the great drawback of engineering as a profession that any one man, however capable, has but scant means of knowing of vacancies which may be yawning to receive him, if he only knew of them, unless they are in some way made matter of public record. It does, undoubtedly, involve considerable trouble to look over dozens of letters of application, investigate the claims made and sift the wheat from the chaff, or rather sift the chaff for wheat, which often is not found. But often, also, it is found, and does not fairness demand that every man who may wish to do so should have a chance to prove himself to be the best man to be had for any given vacancy, whether it be ten miles off or a thousand? "Not ignorant of evil, we have learned to pity the unfortunate." Our experience was and is that one of the greatest drawbacks to a young engineer's life is his small chance to hear of vacancies not in his immediate vicinity for the time being, or not within his immediate circle of acquaintances.

A CORRESPONDENT writes us:

DEAR SIR: I wish to have your opinion as to the propriety of my calling and signing myself "Civil Engineer." I have seen some strictures in ENGINEERING NEWS against the practice of persons giving themselves this title.

I graduated from the Engineering Department of the Pennsylvania State College six years ago, since which time I have used level and transit over several hundred miles of line; have had one residency of 20 miles completed, ready for track, under my charge; have located 20 miles, and had it prepared for track, reporting directly to the chief engineer; have had charge of repairing and arching tunnels for nearly a year, doing all the instrumental work and inspecting material and masonry, and was on maintenance of way, assisting in laying out spurs, side tracks, foundations for machine shops, etc., for eight months. I am now in charge of erection of a large depot for the company, with the title, I believe, of assistant engineer.

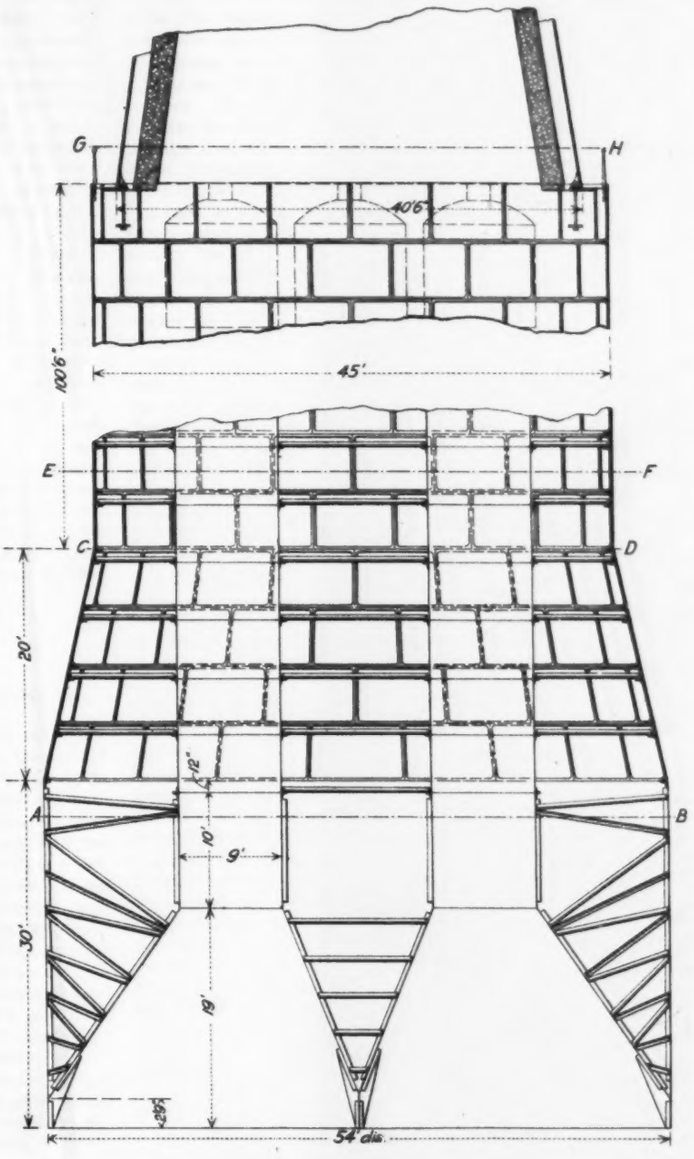
I have also a good knowledge of surveying and opening and operating coal mines, and also enough knowledge of hydraulics to design and build water-works for towns or small cities, though I have not done so yet. I confess I have learned more from ENGINEERING NEWS since leaving college than I learned in my course. I am a Junior Member Am. Soc. C. E.

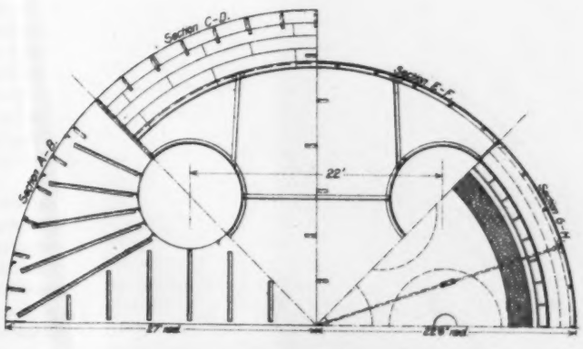
Our correspondent has quite misunderstood us. We have never objected to men of his experience and knowledge calling and signing themselves "civil engineer," whether they be graduates or not. He is a civil engineer beyond all dispute, and has a perfect right to call himself such at all times, although he is not as yet a very experienced engineer, and will doubtless be a much better one ten years from now. What we have objected, and do object, to is that colleges and technical schools should confer the degree of C. E. upon young graduates who have as yet had no practical experience whatever. The only proper degree to be thus conferred, it seems to us, is that of "Bachelor of Science," used by the Massachusetts Institute of Technology, or some equivalent implying, as that does, merely that the graduate has pursued a course of scientific study at the institution.

We have also, however, expressed some sympathy with the objections which certain correspondents have made with the use of the initials "C. E." by those who have not had the right to use them conferred by a degree. At first sight this appears inconsistent with the former view, but it really is not. In former times no one could become a civil engineer except by practical work under older engineers as an articled pupil or otherwise. There were no colleges assuming to produce them by a four years' course of study. The use of the title "C. E." by any one who had in fact reached the status of a practicing engineer, therefore, involved no element liable to deceive. At present, with many colleges conferring degrees of "C. E.," it does involve such an element. The best engineers, therefore, are sparing of the use of this title, even when they have a parchment right to use it. The colleges have degraded it, so that it means nothing. They, therefore, when they use any kind of designation, usually either sign themselves "Civil Engineer" in full, or add "M. Am. Soc. C. E." to their names, when they wish to and have a right to. We advise our correspondent to follow this practice.

WE publish in another column an article relating to the increase of locomotive tractive power by the electric current, which we wish could have been made more complete by definite records of tests showing just what could be gained by just what current, but this is not yet possible. Two facts, however, may be considered as settled: (1) Under certain conditions electric currents of the proper volume and tension do increase by a large percentage the frictional adhesion of wheels to rails; and (2) if this can be effected with locomotives by plant of a simple and practicable kind, it will result in an important increase of their economic efficiency.

The first of these we believe to be established





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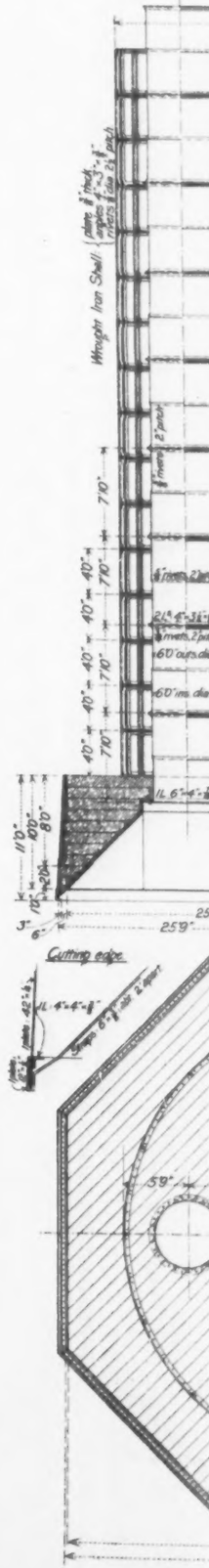

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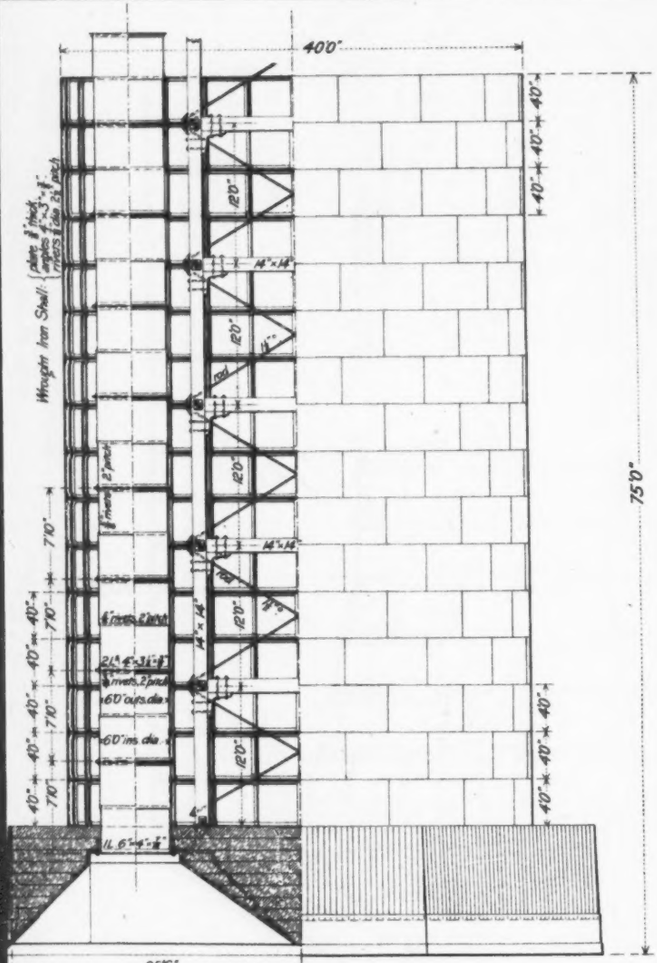

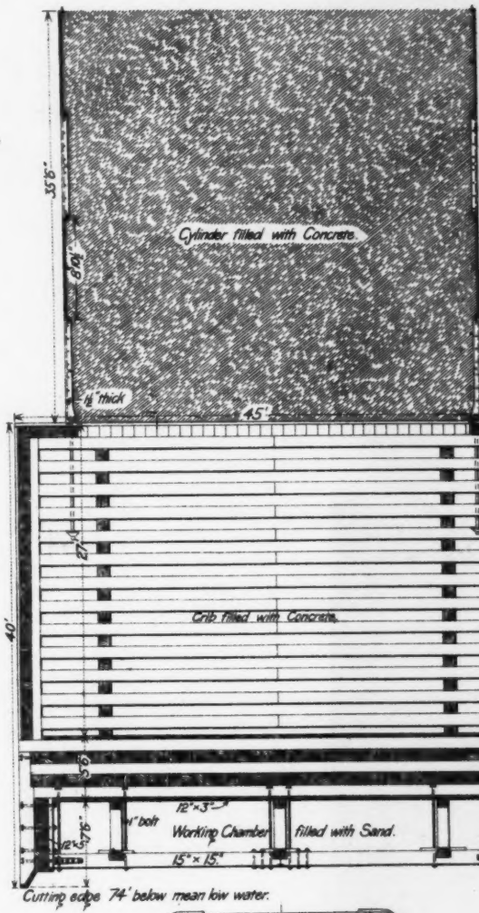
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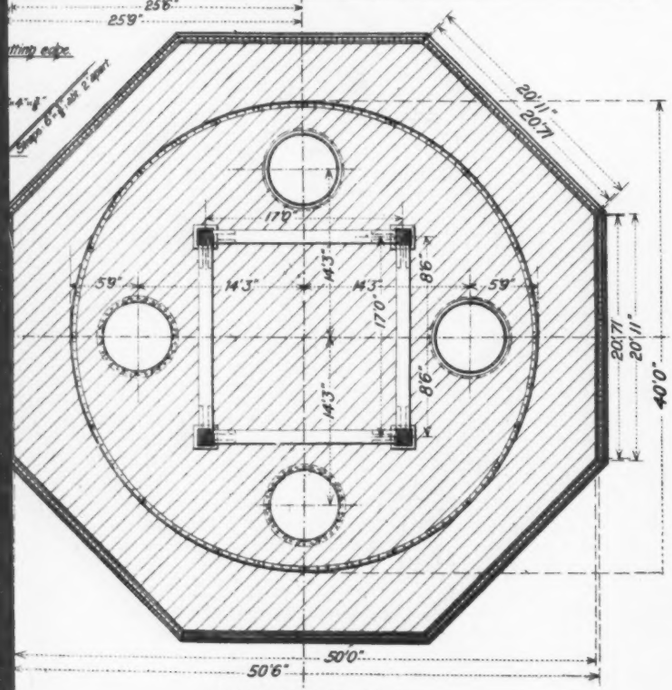

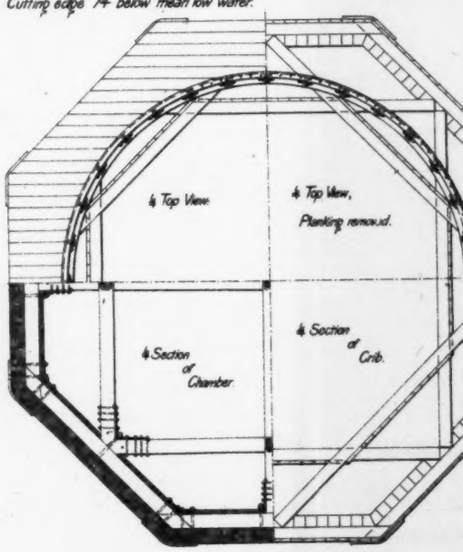

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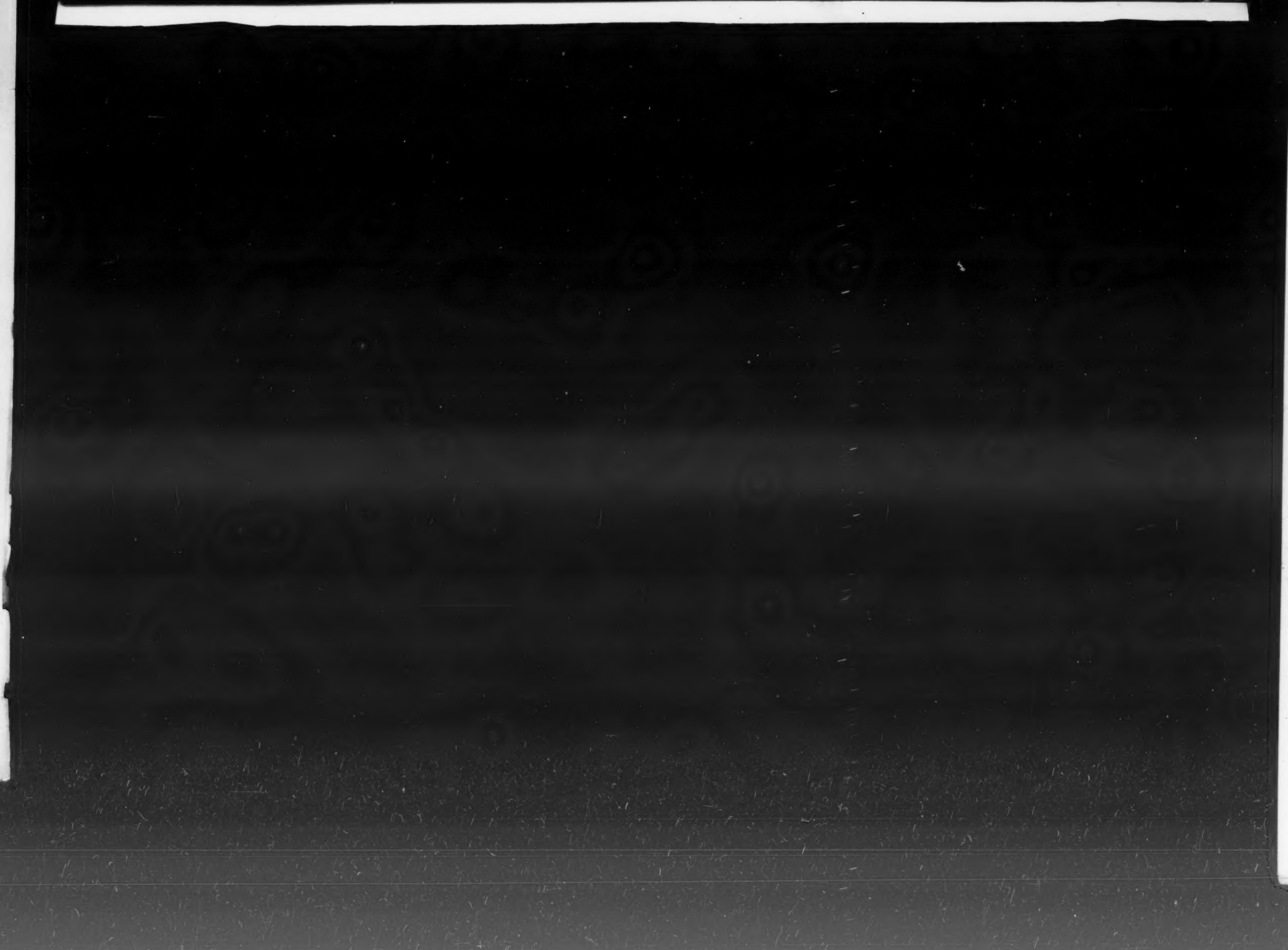

beyond question by the experiments of RIES, DAFT, LYONS, LEVY and SCHMIDT, to mention no others. In a case of this kind, as in most others, negative evidence is of minor importance. The testimony of one credible witness that he heard a bell ring justly outweighs the testimony of a dozen that they did not hear it; and the testimony of two or three credible witnesses that they have produced certain effects with electricity, or with any other agent, justly outweighs the testimony of many others that they have tried to produce the same effect and failed. Their conditions may not have been the same. The conditions for increase of tractive friction are said to be the use of a low-tension "quantity" current flowing in a closed circuit of low resistance moving with the motor; and we think the evidence is good that in this way effects can be produced which cannot be accounted for by natural friction or magnetic attraction, or both, and which seem to imply some molecular effect of the current on the metal. That such effects are practicable on a large scale, or commercially practicable on any scale, remains to be proved, however. We have no such evidence before us as yet; but we shall deem it of great importance if produced, since the effect to cheapen transportation of a controllable temporary increase of tractive power not accompanied by increase of the load on wheels would be very great.

The Production of Heat from Electricity.

In all the history of science and the arts there has never been recorded anything like the present popular craze on the subject of electricity. The steam engine had to slowly win its way into popular favor, but electricity in its various applications has secured a hold upon the popular mind wholly different from that of any other great natural agent. Why this should be so is not difficult to understand. The energy of the electric current manifests itself in so many and such totally diverse ways, creating, at one point of the circuit, light, at another, heat, at another, force, and at another, power, that to the uneducated mind its possibilities appear endless. Then, too, men have seen such surprising things done with applied electricity. The telephone, the phonograph, the electric welder, the electric railway, the electric motor, the storage battery, all appeal strongly to the popular mind. If these surprising feats can be performed by electricity, almost anything can be done, says an amazed and interested public.

It is for this reason that electric inventions find ready backers and a quick market. Fraudulent enterprises, like the electric sugar refining process, find victims eager to be fleeced, more eager before than after the operation. The money which is today being sunk in experiments for the perfection of electric inventions of no possible practical value is probably greater even than the millions which have been wasted on patent car-couplers.

To be sure many inventions which at first sight seem extravagant and impracticable, afterward are found to be of great value. It is not always possible for even the best trained engineers to determine beforehand an invention's practicability. Of a certain class of inventions however, it is always possible to predict what their outcome will be. We refer to those which are seen to be impracticable by reason of the law which lies at the base of modern science, concerning the conservation and correlation of energy.

Simple as this law is, there is hardly a conclusion of modern science which is as little comprehended by people at large as this important and fundamental truth. Even educated engineers are often found to have as little realization of the profound importance of this law, as if it were of use only in abstract scientific investigation.

A very good example of the popular ignorance of this law is an item which recently appeared in the New Orleans *Times-Democrat* describing a wonderful invention which had been seen by a Chattanooga reporter, who surreptitiously gained an entrance to the place where the machine was at work. The invention consisted of a 30 HP. dynamo, the electric current from which was led through resistance coils in the tubes of a 40 HP. boiler, generating heat there and thus making steam in the boiler. The steam from this boiler was used to run a dynamo (40 HP., of course) which would in turn get up steam in an 80 HP. boiler. The *Times-Democrat* artlessly remarks that "this is the first instance on record where power could be increased. Nature has always worked the other way." That in this age of progress a great metropolitan journal like the *Times-Democrat* could be induced to give publicity to such a palpable hoax is simply an illustration of the dense popular ignorance on these subjects. Perpetual motion, the present generation has at last come to understand, is a snare and delusion. But they do not at all understand why; and when the electric current is brought in as part of the humbug, they go back to their old implicit faith in it, and the work of proving their folly to them has to be begun anew.

Another instance of the same thing is the fact that the general public can never be induced to take much interest in the prospects of an exhaustion of the world's coal supply and with it, perhaps, the end of civilized man's existence. "Oh, well," is the reply when the subject is broached, "by the time the coal is gone we will have something else to use." Ask what the something else may be, and nine times out of ten the answer will be electricity. In the popular mind, indeed, there is no comprehension of the fact that the electric current is subject to fixed and unalterable laws, the same as any other physical manifestation of energy.

Among the numerous lines of impracticable inventions referred to above is the production of heat from electricity. We do not now refer, of course, to the class of inventions which utilize the electric current for heat for special uses, as the welding or smelting of metals, the heating of various instruments, etc., but to the numerous schemes for warming buildings, cars, etc., by the electric current. That this is not only theoretically but practically possible is, of course, true; but the commercial test is the one by which an invention must stand or fall, and by this test the electric radiator is at once seen to be nothing more than a scientific toy.

The most surprising thing about this matter is that even electrical engineers seem slow to perceive this fact. Of course, not much is expected of the trade papers; but it is not only these but the journals of high standing, representing the electrical engineering profession, which have given countenance to the "electrical radiator" idea. As a single instance of this we find in *The Electrical Engineer* of July 16 the leading editorial to be on "Banishing the Steam Pipes." Referring to the present tribulations of the New York Steam Company, and the greater tribulations of New York's residents, whose health and property are endangered by the steam company's conduits, our contemporary advocates the substitution of electric motors for the steam engine. It alleges what is probably true, that the power can be distributed much more economically and safely over an extended area by electric wires than by steam mains. In its concluding paragraph, however, it refers to the use of electricity for heating as follows:

> One point, however, has yet to be dealt with by electrical inventors and engineers. We refer to the use of the steam for heating as well as power purposes. This double necessity will not escape the notice of far sighted men; and then another step in advance will have been made.

Now for the sake of showing just what are the possibilities in the distribution of heat by electricity in so plain a manner that the dullest may understand it, let us take a practical example.

Suppose a building which is now heated by an ordinary gravity return steam system, requiring say 50 tons of coal per year, is to be heated by electricity. We may fairly assume that the steam heating plant evaporates 10 lbs. of water from and at 212° per lb. of coal, and *all* the heat in this steam is used in heating the building. The condensed water returns to the boiler at a temperature of nearly 212°, or if it returns at a lower temperature it is because more heat has been radiated in the building. There is little or no loss of heat even by radiation from the boiler and from the steam mains running through the building, since this heat warms the halls and basement. This apparatus, therefore, generates $10 \times 965.2 = 9{,}652$ heat units per pound of fuel, which is utilized in heating.

The electrical heating apparatus must have, of course, an equal capacity for supplying heat.

The first mechanism for the production of heat by electricity are the boiler, engine and dynamo at the central station. The boiler may perhaps be as economical as the steam heating boiler. It will probably have more careful firing; but on the other hand, it will work at a much higher pressure; and while its "air excess" will probably be less, the gases will enter the chimney at a higher temperature than in the steam heating boiler. Let us suppose, however, that by the use of good coal, careful firing, well designed boilers and triple-expansion engines, we are able in daily practice to generate 1 HP. per hour delivered at the fly-wheel (not *indicated* HP.) with an expenditure of 2½ lbs. of coal.

We have then to convert this mechanical energy into electricity by a dynamo, transmit it by wire to the place where heat is desired, and convert it into heat by passing it through a resistance coil. We may set the combined efficiency of the dynamo and line circuit at 85 per cent. at most, and for the sake of argument will suppose that *all* the electricity is converted into heat in the resistance coils of the radiator. Then 1 brake HP. at the engine = 0.85 electrical HP. at the resistance coil = 1,683,000 ft. lbs. energy per hour = 2,180 heat units. But since it required 2½ lbs. of coal to develop 1 brake HP., it follows that the heat given out at the radiator per pound of coal burned in the boiler furnace will be $\frac{2{,}180}{2\frac{1}{2}} = 872$ H. U. The ordinary steam heating system, as shown above, utilizes 9,652 H. U. per lb. of coal for heating; hence the efficiency of the electric system is to the efficiency of the steam heating system as 872 is to 9,652, or about as 1 is to 11. Then if the building which requires 50 tons of coal per annum when heated by steam is to be heated by electricity, 550 tons will be required. With the utmost fuel economy which the steam engine has ever developed, this would only be reduced to some 300 tons against 50 tons for steam heating.

As a mere matter of curiosity some allusion may be made to the plant required: A steam heating plant using 50 tons of coal per annum in this climate ought to have a maximum capacity of not less than ⅔ of a ton of coal in 12 hours in order to furnish steam enough for the coldest days. Taking the efficiency above noted—9,652 H. U. per lb. of coal—this means a total of 16,891,000 H. U. in 12 hours, or 1,407,582 H. U. per hour.

Suppose our electrical heating plant to generate a similar amount of heat; then since it gives out 2,180 H. U. per brake HP., the total brake HP. of the engine required will be $1{,}407{,}583 \div 2{,}180 = 645$.

It needs hardly an elementary knowledge of mechanical engineering to perceive that the boilers, engines and dynamo to generate 650 HP., with the building to cover them and all the auxiliary plant, would cost a sum which makes the whole scheme ridiculous. No reference need be made to the size and cost of the copper wire needed to transmit 650 HP., nor to the cost of operating the plant, with the engineers, firemen, machinists, etc., which would be required.

But some objector may say that while it is true that in heating buildings where large amounts of heat are required, electricity is impracticable, it may find a use in heating railway cars. Let us see how much heat is required for this purpose:

Experience seems to show that 65 lbs. per hour of steam at 25 lbs. pressure is a fair average for cars in zero weather. This is equal to 63,895 H. U. per car per hour, or for a 7-car train, 447,265 H. U. For the electrical heating system described above we counted on an efficiency of 2,180 H. U. per brake HP., but with a dynamo mounted on the locomotive boiler it is doubtful if so much could be obtained. Supposing that it could, we should have for the HP. of the engine and dynamo required 447,265 ÷ 2,180 = 205. In view of the fact that there is no particular obstacle in the way of warming trains by steam from the locomotive, inventors of electric car-heaters would be wise to engage in some more profitable business. Even if the plant were economical, railway managers would be slow to perch a 200-HP. engine and dynamo on top of their locomotives.

It is probably too much to expect that the simple but fundamental laws of energy will be generally grasped during the present generation; but it is the duty of every engineer to post himself upon them, and, so far as is possible, to keep hare-brained inventors and ignorant capitalists from throwing away money in fruitless attempts to perfect inventions which can be seen at once to be of necessity commercially impracticable.

Family and Meter Water Rates in the United States and Canada.

A comparison of the water rates of cities is one of the most accurate methods which can be employed in judging of the efficiency of the management of their water-works, since the expense of their maintenance is largely met by the revenue derived from consumers. This is more especially true when the works are owned by the municipality within which they are located, for in such cases the aim is generally to keep the rates as low as possible and still realize enough to maintain and operate the works. Companies, of course, furnish water for profit, and therefore a comparison of their rates with those of public works, and with each other, is often desirable in order to ascertain whether they are furnishing water at reasonable figures, while the comparison of a few or all the rates of one class with a corresponding number of those of another is a valuable aid in determining the relative advantages of public and private ownership.

It is well known that the establishment of a satisfactory or even a just schedule of rates is one of the most difficult tasks which water-works officials have to perform, and that these rates are often a bone of contention between private companies and municipalities.

In view of these facts we have collected and tabulated for MANUAL OF AMERICAN WATER-WORKS for 1889-90, the family and meter water rates of about 800 cities in the United States and Canada, and we present herewith some deductions therefrom. These rates were in force in 1889, and are abstracted from printed schedules kindly sent us by the various works. We requested rates from every water-works listed in the MANUAL for 1888, and in every case where our first request brought no reply we sent another, and still others to many works. We have published and summarized in this issue of the MANUAL all the rates received. This table of rates is given on the opposite page.

Only family and meter rates have been included, as most of the others could not be readily and intelligibly tabulated within small compass. Besides, the rates selected cover the ground admirably, as private consumers are by far the largest and most important class the country over, and the rates of large consumers are generally best indicated by meter charges.

Notes from Abroad.

[EDITORIAL CORRESPONDENCE.]

THE COUILLET IRON AND STEEL WORKS.

During a brief trip in Belgium I had the pleasure of visiting the celebrated works of the Société Couillet, near the town of Couillet. These works include blast furnaces, rolling mills for rails and structural iron, foundries for iron and steel, a Martin-Siemens steel plant, and locomotive, boiler and machine shops. The rolling mill has several trains of rolls, including a train for rolling wire. At the time of my visit some large I-beams were being rolled; from the rolls they were moved to the saw, by which they were cut to the desired length, and were then laid on an iron bed plate and straightened by blows from a heavy wooden mallet wielded like a sledge hammer. The beam was moved to the saw over a set of rollers whose surface was just above the level of the floor, and the beam remained stationary while the circular saw (which was provided with teeth) traveled through it. One of the most interesting pieces of work then in hand was the making of steel ties for the Congo Railway, described in the next paragraph. Some heavy work is also being done in cast steel armor; this work consists of large pieces to form turrets, or rather cupolas for the new Belgian forts along the river Meuse; the pieces resemble in form those made at the Gruson works and described in ENGINEERING NEWS, April 30, 1887. The Couillet works have also a contract for gun carriages and turntables for these cupolas. In the locomotive shops a number of engines were undergoing repair, including one of the miniature engines used to haul material about the works on a narrow gauge railway. It may be mentioned here that these engines, like many Belgian locomotives, are fitted with the Walschaerts valve gear; although apparently complicated, this gear is said to give very little trouble and to be satisfactory in its distribution of the steam. In the erecting shop was a narrow gauge tank engine for Greece; it was of the mogul type, with six coupled wheels, a single leading axle, and outside cylinders. The tanks were on the frames, at the side of the boiler, and the engine was fitted with hose for continuous brakes. In this shop was also a small tender for the locomotive of a portable railway on the Decauville system. The week before my visit the works had completed their thousandth locomotive. In the machine shop were a number of English tools. Near the works are mountains of slag from the furnaces, with an elevated wire tramway carrying iron buckets. The offices are in a large and well equipped building, and here I had the pleasure of making the acquaintance of Mr. MAROQUIN, Director of the works, and Mr. TAHON, Engineer of the rolling mills.

METAL TIES.

The Congo Ry., which is to run from Matahdi to Stanley Pool, a distance of over 250 miles, is to be laid with steel flange rails supported on iron ties of the type invented by Mr. WILLEMIN, and generally known as the Z-tie (see ENGINEERING NEWS, Sept. 7, 1889). The railway is to be a narrow-gauge line, and I understand that work has already been commenced. The ties are composed of two bars of Z or double angle section, the top flanges being outward and the lower ones inward, while the web is vertical. They thus form a sort of box, open on top and nearly closed on the bottom. Near each end of the tie is a cast-iron chair resting between the two Z-bars, and connected by two (or for large ties three) rivets. The chair projects a little above the top of the tie, and forms a seat for the rail, having lugs to hold the flange of the rail. At present the riveting is done by hand, but I was informed at the works that if large orders are given, a power riveting plant will be arranged. The ties for the Congo Ry. weigh about 70 lbs. complete, but when in the track and packed with ballast the weight will be about 90 lbs. One of the special advantages claimed for this type of tie is that of economy in weight of metal, with ample weight when in the track, the ballast being filled in to the top of the tie. On the Congo Ry. the ballast will be of hard broken stone, which will be obtained from some heavy cuts along the line. The fastening of the rail is extremely simple, consisting merely of a slightly tapered key. The rail is placed on the chair, with one side of the flange held by one lug of the chair, and the key is then driven between the flange and lug on the other side of the rail. The direction for driving the key is indicated by an arrow cast on the lug. In keying up, a light hand hammer only is used, as the use of a sledge would result in breaking off the lugs of the chairs. The ties are in use on a metre gauge steam tramway at Charleroi, and are to be tried elsewhere; including Portugal, and Loando and Tunis in Africa. I visited the line at Charleroi in company with Mr. LAIRLETTE, the Director, and the easy and quiet riding of the cars was very noticeable. At a part of the line where the track had not been disturbed for three years, Mr. LAIRLETTE had the ballast dug up, and I found that the keys were quite tight, allowing no motion between the rail and tie, and thus accounting for the quiet running of the trains. Wooden ties are now used at switches and crossings, but the metal ties are to be employed at such places on a new line under construction. The ties now made have the Z-bars of wrought iron, that material being as good as, and now much cheaper in Belgium than steel; but mild steel may equally well be used. In the Belgian State railways I found that metal ties were not regarded with favor by the engineers. All the ties of the Bernard type have been taken up. The steel ties now in use are of the Post and Braet types; the former is the type designed and used by Mr. POST, Engineer of Permanent Way of the Netherlands State railways, and the latter is merely a modification of the same which is not as satisfactory as the original. The ties were made in 1885 at the Angleur Works, in Belgium, since which time Mr. POST has introduced several improvements. Some of the engineers had the ballast dug up to show me the way in which the steel ties held water and churned the broken stone ballast into mud; while the opposite track, laid with wooden ties, was not so wet. On several of the ties, from which the bolts were removed, I found cracks radiating from the corners of the bolt holes, and there was also appreciable wear of the rail seat. The bolt holes were of rectangular form, with rounded corners; they were punched. It is due to Mr. POST to state, however, that he has continued to improve his tie, and that he now has the bolt holes drilled and made oval instead of rectangular. Specimen ties have been bent at these holes; those with rectangular punched holes cracked, but those with oval drilled holes showed no injury. Full particulars of these and other metal ties will be found in my report on "The Substitution of Metal for Wood for Railway Ties," which is to be issued this summer by the U. S. Department of Agriculture.

CONTINUOUS BRAKES.

In England different kinds of continuous brakes are used, both air and vacuum, instead of the uniformity of practice which prevails in America. Some cars for through routes have to be fitted with both, necessitating two sets of brake hose. The Westinghouse air brake is used on a number of lines, but there is no attempt at uniformity, and freight trains are run with merely a "brake van" to a certain number of ordinary cars. Freight cars have clumsy brakes applied by a long, heavy lever at the side; but this can only be applied by a man on the ground, and is therefore only applicable for switching operations. I have just received drawings of an improved form of brake for English freight cars. In Germany freight trains must have a brake car to a certain number of axles in the train. In France I found the Westinghouse brake on the Western Ry., and a non-automatic vacuum brake (the Smith-Hardy, I believe), on the Northern Ry. In Belgium the Westinghouse brake is generally used, exclusively, I believe, on the Belgian State railways. Some of the engines of these lines have to be fitted with a vacuum brake in order to haul the Paris and Brussels through trains of the Northern Ry. of France. The French engine takes the train to Mons, a frontier town, and a Belgian engine takes the same cars on to Brussels. The Belgian engines fitted for the vacuum brake make a great noise whenever the brake is applied, owing to a lack of a muffler. The Westinghouse brake is used in Holland, and in some of the cars there is a handle by which the passengers can apply the brake in case of emergency.

THEATRICAL ENGINEERING.

At a "spectacular" play in Paris, called "The Orient Express," a real train was advertised as a feature of the last scene, for which reason I sat out

FAMILY AND METER WATER RATES IN THE UNITED STATES AND CANADA.

TABLE 1—R.

FAMILY AND METER WATER RATES OF 800 CITIES IN THE UNITED STATES AND CANADA—AVERAGES BY STATES AND PROVINCES, OF RATES FOR VARIOUS FAMILY PURPOSES, AND OF METER RATES, TOGETHER WITH AVERAGE COST OF WATER-WORKS PER FAMILY OF FIVE, AND AVERAGE POPULATION ON THE WORKS UNDER CONSIDERATION.

	Present population.	Family rate.	Pan closet.	Bath tub.	Wash bowl.	Horse and carriage, with use of hose	Cow.	Hose.	Total for family	Cost of works per family.	Range of meter charges per 1,000 galls., in cents.
Maine.											
All works..	9,409	7.63	4.53	4.19	0.87	5.5	1.53	3.5	25.87	167.3	23½-9¼
Pub. " ..	23,500	5	1.5	2	0	2	1	2	13.5	119.9	22½-2½
Priv. " ..	8,460	7.8	4.73	4.33	0.93	5.75	1.57	3.5	26.73	181.3	25-16
New Hampshire.											
All works..	6,348	6.64	3.6	3.5	0.7	5.03	1.16	4.2	24.9	107.4	27-18.3
Pub. " ..	12,167	6.7	2.41	3.1	0.8	3.5	0.95	3.5	20.4	106.4	25-10.5
Priv. " ..	4,020	7.07	4.1	3.63	0.66	5.53	1.23	4.43	26.4	123.8	27.7-20.6
Vermont.											
All works..	5,000	6.43	3.9	3.23	0.87	3.27	1.36	3.95	22.4	76	40-13⅓
Pub. " ..	7,250	6.66	3.5	3.08	0.50	2.16	1.16	2.91	19.6	81	40-13⅓
Priv. " ..	3,313	6.25	4.4	3.4	1.3	4.6	1.7	5.2	25.8	62	
Massachusetts.											
All works..	16,810	6.46	4.35	4.25	1.32	5.76	1.51	4.51	27.09	106.34	29.33-17.6
Pub. " ..	23,928	6.07	4.27	4.11	1.34	5.09	1.48	4.37	24.74	107.04	27.39-16.3
Priv. " ..	5,597	7.15	4.46	4.5	1.31	6.9	1.55	5.0	31.16	101.42	35. -22.2
Rhode Island.											
All works	26,550	7.12	5.16	5.16	2.3	9.43	1.3	6.14	35.36	187.61	33.75-18.0
Pub. " ..	82,500	5.5	5.0	5.0	2.3	9.5	1	5.5	28.85	223.9	30-10.5
Priv. " ..	4,566	8.0	5.2	5.2	2.3	9.4	1.5	6.4	38	193.61	36-26.2
Connecticut.											
All works..	13,250	5.8	3.35	3.29	0.25	5.13	1.06	4.14	23.62	92.23	27 -12.64
Pub. " ..	14,500	5.1	2.85	2.5	0.15	3.5	1.05	3.05	18.66	98.82	27.4 -13.6
Priv. " .	11,025	6.05	3.6	3.84	0.30	5.95	1.08	4.62	25.87	87.55	26.36-12.72
New York.											
All works..	31,835	6.9	3.35	3.23	0.87	4.44	1.14	4.92	24.74	156.39	39 -13.29
Pub. " ..	69,914	6.1	2.50	2.63	0.61	3.31	0.86	3.85	19.43	112.33	33.4-17.9
Priv. " ..	9,125	7.53	3.96	3.71	1.15	5.36	1.37	5 81	29.18	164.52	43.6-13.6
New Jersey.											
All works..	24,532	8.11	3.29	3.96	1.04	3.42	1.34	4.72	25.27	110.52	28.99-18.6
Pub. " ..	42,042	8.08	2.71	3.50	0.83	2.60	1.30	4.04	20.31	103.31	29.48-16.51
Priv. " ..	13,316	8.14	3.60	4.33	1.20	4.50	1.37	5.27	28.23	124.73	28.49-20.69
Pennsylvania.											
All works..	25,148	7.46	3.7	3.61	1.1	3.86	0.81	4.36	23.91	89.98	27.72-13.4
Pub. " ..	87,122	6.75	2.71	3.7	0.9	3.02	0.80	4.06	21.45	85.8	19.75-09.03
Priv. " ..	7,155	7.66	3.17	3.51	1.16	3.94	0.81	4.45	24.63	106.3	31.71-16.09
Delaware.											
All works..	16,666	5.33	3	3	1	2.92	1	3.75	20.66	74.7	20-12.50
	All public works.										
Maryland.											
All works..	102,750	5.71	2.1	2.27	0.31	2.92	1.3	4.38	20.35	137.4	20.35-01.9
Pub. " ..	400,000	12	0	0	0	3	1	3	19	140.2	6-6
Priv. " ..	3,666	3.62	2.8	3.03	0.41	2.9	1.4	4.83	20.80	38.6	25-23.33
District of Columbia.											
All works..	160,000	5.5	0	0	0	1.5	0.250		7.25	265	3-3
	One public work only.										
Virginia.											
All works..	18,983	6.63	3.08	3.21	0.58	4.07	1	4.82	24.25	82.2	22 -14.4
Pub. " ..	21,644	6	3.11	3.28	0.39	3.88	1	4.69	23.44	82.2	21.66-12.23
Priv. " ..	11,000	8.5	3	3	1.16	4.58	1	5.17	26.42	82.1	22.5 -17.5
West Virginia.											
All works..	14,000	6.5	4.5	2.69	0	2.5	1	6.19	23.38	91.6	26.66-13.33
Pub. " ..	16,000	6	4.33	1.92	0	2	1	6.25	21.5	93	15 -10.5
Priv. " ..	8,000	8	5	5	0	4	1	6	29	79	50 -20
North Carolina.											
All works..	10,416	8.08	4 62	3.83	1.5	4.08	1.47	5.07	28.45	68.5	31.67-2.33
	All private works.										
South Carolina.											
All works..	60,000	12	4	4	1	12	0	6	39	33.3	60-25
	One private work only.										
Georgia.											
All works..	24,213	7.39	3.14	5	1.67	4.25	0.5	6	30.88	47.9	25 -18.33
Pub " ..	31,250	6.66	3	5	0 33	3.17	0.5	6.66	27	44 5	16.66-12.5
Priv. " ..	14,666	10.58	4.33	5	3	5.33	0.5	5.33	34.75	57.5	50 -30
Florida.											
All works	11,000	10.2								55.3	35.25-15.33
Pub. " .	25,000	12								23.4	16 -9½
Priv. " ..	7,500	9.75	4	5.25	2.5	4.5	1.38	8.5	37 88	81.8	41.66-17.33
Alabama.											
All works..	16,786	12	5	5.29	1.5	5.56	1.56	7.71	38.64	128.7	36.5-25
	All private works.										
Mississippi.											
All works..	15,000	10	5	5	2	8	2	11	43	58.3	50-50
	One private work only.										
Louisiana.											
All works..	85,333	10.33	5.16	5	1	4.16	1.33	10.5	37.5	53.1	40-20
	All private works.										
Tennessee.											
All works..	34,500	9.86	4.86	5.71	0.86	5.71	2.29	7.5	36.94	88.5	29-15.2
Pub. " ..	80,000	12	6	8	0	4	2	5	37	131.3	15-7
Priv. " ..	26,917	9.92	5.67	5.33	1	6	2.33	8.08	43.1	64	32.5-17.25
Kentucky.											
All works..	31,911	8.01	4.61	5.17	1.75	3.39	1.28	4.11	31.65	125 9	26.25-16.5
Pub. " ..	21,000	9.62	5.25	5.62	1.25	2.88	1.38	4.25	30.25	99.1	27.5-16 5
Priv. " ..	40,640	6.6	4.1	4.8	2.15	3.8	1.2	4	32.77	136.9	25.-16.5
Ohio.											
All works..	28 592	7.09	2.76	3.06	0.80	2.48	1.11	3.29	20.31	107.1	29.1-15.01
Pub. " ..	9,388	7.03	2.63	3.06	0.54	2.5	1.14	2 65	19.52	106.9	22.47-11.78
Priv. " ..	10,000	7.2	2.97	3.06	0.47	2.4	1.07	4.36	21.63	114.5	37.64-18.02
Indiana.											
All works..	19,456	6.17	3.04	3.36	0.76	3.29	1.24	3.46	21 33	63 60	31.76-8.6
Pub. " ..	14,625	4.85	2.58	2.6	0.71	2.3	0.94	2.25	16.22	38.61	2.3-5.83
Priv. " ..	24,727	7.62	3.55	4.18	0.82	4.39	1.56	4.77	26.9	79.87	35.45-9.8
Michigan.											
All works..	15,931	6.47	2.76	2.4	0.28	2.57	1.09	4.28	20.05	80.6	29.75-14.55
Pub. " ..	18,327	5.54	2.44	2.2	0.24	2.1	0.96	4	19.6	32.29	27.41-14.79
Priv. " ..	8,140	9	3.86	2.94	0.39	3.9	1.44	5.19	26.42	70.36	36.71-15
Illinois.											
All works..	36,681	7.53	2.9	2.98	0.74	2.89	1.17	4 55	22.74	79.86	30.28 13.13
Pub. " ..	50,039	6.51	2.69	2.18	0.52	2.54	0.93	4.24	19 82	78.73	25.78-12.18
Priv. " ..	11,181	8.64	3.27	4	1.15	3.5	1.6	5.15	27.78	89.43	39.17-14.38
Wisconsin.											
All works..	20,444	7.73	3.53	3.48	1.22	3.99	1.2	4.32	25.47	83	36.13-11.21
Pub. " ..	34,714	8.43	2.8	2.57	0.14	2.64	0.71	3.14	20.71	76.7	39.24-12.76
Priv. " ..	11,364	7.3	4	4.05	1.91	4.84	1.52	5.07	28.5	95.3	33.9-12.5
Iowa.											
All works..	11,293	7.08	3.2	3.34	0.13	4.07	1.12	5.23	24.12	79.12	39-16.86
Pub. " ..	5,492	6.04	2.71	2.93	0.0	3.25	0.92	4.77	20.67	45.1	37.3-16.4
Priv. " ..	16,679	3.05	3.06	3.73	0.27	4.77	1.31	5.7	27.31	89.52	40.45-32.31
Minnesota.											
All works..	53,438	7.08	3.38	3.31	1.19	3.19	1.5	3.25	22 89	68.75	31.14-12.46
Pub. " ..	94,250	4.66	2.75	2.38	0.38	2.5	1.38	3.25	17.28	63.84	22-9.31
Priv. " ..	12,625	9.5	4.5	4.25	2	3.88	1.63	3.25	28.5	105.44	43.33-12.5
Kansas.											
All works..	9,067	7.96	2.78	3.29	0.9	4.18	1.2	4.89	24.52	76.64	41.47-18.21
Pub. " ..	3,770	7.91	2.68	2.67	0	2.64	1.15	4.6	2.31	93.66	40.83-21 5
Priv. " ..	11,326	7.98	2.82	3.53	0.13	4.68	1.22	5.02	25.38	74.19	41.76-16.96
Nebraska.											
All works..	13,750	7.19	2.81	3.13	0.29	2.63	1.14	4.85	22.16	106.55	31.41-13.61
Pub. " ..	7,031	6.45	2.44	2.78	0.13	2.06	1.03	4 15	19.05	31.62	30.21-13.05
Priv. " ..	35,625	9.63	4	4.25	0.5	4.5	1.5	7.13	32.25	156.36	35-15
South Dakota.											
All works..	5,440	12.4	3.8	3	0.2	4	0.7	5.8	30.7	70.05	52.5-17.5
Pub. " ..	3,733	11.25	2 5	1.83	0.0	2.67	0.67	4.17	23.8	49.77	
Priv. "	8,000	14.13	5.75	4.75	0.5	6	0.75	8.25	42.13	84.22	52.5-17.5
North Dakota.											
All works..	4,750	16.5	5	3.5	1.5	5.5	1	1.78	34.80	94.74	50-20
	One public and one private work.										
Montana.											
All works .	5,500	15.5	2.5	5.5	1	11.5	2.5	9.75	48 25	90.91	75-60
	All private works.										
Missouri.											
All works..	54,179	7.65	3.78	4.15	0.05	4.92	1.71	3.81	26.56	133.39	39-16.66
Pub. " .	450,000	7	5	5	0	8	1.5	2.5	29	148.03	30-10
Pr v. " ..	23,731	7.71	3.43	3.25	0.06	4.66	1.67	3.91	26.4	111 67	39.6-17
Arkansas.											
All works..	15,333	10.67	4	4.83	0	6.33	2.67	3.17	31.67	49.57	35 15.83
	All private works.										
Texas.											
All works .	12,700	14.79	5.55	6.12	0	8.56	1.17	8.02	44.8	61.44	53.46-27.79
Pub. " ..	25,300	9.54	5	5.32	0.40	5.67	6	5.37	31.9	48.52	37.5-20
Priv. " ..	9,200	16.43	5.73	6.6	0.09	9.59	1.38	8.9	49.41	70.74	56.82-28.5
Colorado.											
All works..	9,273	14 26	4.73	4.19	0	5.45	1.62	6.24	36.36	89.75	51.88-22.5
Pub. " ..	3,513	15.56	4.94	3.64	0	4.73	1.29	5.18	33.36	126.78	80-28.75
Priv. " ..	14,394	13.11	5	4.75	0	6.29	2	7.31	39.79	81.72	42.5-21.46
New Mexico.											
All works..	5,500	24	4	4	1	8	4	17.5	63.5	100	63.5-43.75
	All private works.										
Washington.											
All works..	15,667	19	6	4	0	4	3	1.67	37.67	51.78	21.67-15
Pub. " ..	8,500	21	6	3	0	3	3	0	36	54 71	20-15
Priv. " ..	30,000	15	6	6	0	6	3	5	41	50	25-15
Oregon.											
All works..	6,833	16.67	8.43	6	0	9.43	5.71	8.2	54.94	67.48	44.17-31.94
Pub. " ..	14,733	13	6.67	2	0	8	3.4	4.13	37.2	72.97	38.33-27.22
Priv. " ..	2,883	18.5	9.75	9	0	10.5	6.75	11.25	68.25	53.47	51.67-36.67
California.											
All works..	16,419	19.53	6.04	4.2	0	6.26	2.78	5.68	46.13	289.71	53.28-37 13
Pub. " ..	35,000	12	0	4	0	10	4	4.8	34.8	51.14	45½-22½
Priv. " ..	15,819	19.76	6.26	4.21	0	6.13	2.74	5.71	46.54	302.67	53.62-37.71
	One public work only.										
Arizona.											
All works..	7,000	24	8.4	0	0	6	3	4.8	46.2	56	70-40
	One private work only.										
Utah.											
All works..	20,000	8	1	1	0	4	1	5.5	20.25	63.25	20-20
	All public works.										
Idaho.											
All works..	2,000	21	0	0	0	4	1.5	6	33.5	33.75	
	All private works.										
New Brunswick.											
All works..	7,000	5	5	3	1	5.5	1	3	23.5	79.3	25-15
	One public work only.										
Nova Scotia.											
All works..	15,000	7.07	4	2.67	1.33	7.25	1.13	3.25	29.9	90.5	
Pub. " ..	17,778	5.5	3.67	1.5	6.5	3	0.5	1.5	16.75	81.98	50 35
Priv. " ..	7,000	10.2	5	5	3	20	3	10	56 2	155	50 35
Prince Edward Island.											
All works..	12,000	6	5	3	1	3	1	2	21	63.75	30-30
	One public work only.										
Quebec.											
All works..	38,275	13.76	3	1.33	0.29	2.06	1.25	2 9	25.36	182.67	31⅔-10⅔
Pub. " ..	48,033	1 .66	2.8	0.8	0	1.7	0.9	1.63	22.45	155 41	30-15
Priv. " ..	9,000	14	4	4	1	4	3	8	37	70.05	25-20
Ontario.											
All works..	16,391	7.85	3.21	2 83	0.57	2.23	1.13	4.7	22.27	102.4	30.55-19.05
Pub. " ..	19,900	7.71	3.01	2.61	0.47	2.13	0.95	4.48	21.12	108.3	32.90-18.07
Priv. " ..	8,971	8.03	3.75	3.42	0.71	2.5	1.56	5.16	25.01	70.4	27.27-21.74
British Columbia.											
All works..	15,000	15.6	3	6	0	6	3	6	*39.6	83.33	60-sp.
	One private work only.										

a rather dreary and apparently interminable performance. After a long wait between the acts the curtain rose and disclosed the interior of a railway station (supposed to be Buda-Pesth) with some painted locomotives of fearful and wonderful design, and a little narrow gauge track of portable railway coming down the stage from the back and making a sharp curve to an exit almost at right angles at the side. After considerable delay and a lengthened business among the actors, a little engine appeared at the back of the stage and started slowly toward the front, but came to a dead stop, while the audience cheered and roared. But something was wrong and a crowd of attendants collected and made great efforts to repair the disaster, while the actors prolonged their leave-taking business. Finally, the engine was uncoupled and ran down the track; it was a little 4-wheeled engine, with a conical stack and side tanks, such as is used for plantation or contractors' lines of portable railway. The front car was off the track, but through the open front door it could be seen to be arranged as a dining car. As a "real stage railway" it was interesting, but as an advertisement of the Decauville portable railway it was not a success. However, no doubt the train ran without accident on following nights, and the Decauville system is too well known and too widely used to be damaged by such a *contretemps*. On another evening, at the Hippodrome, I noted that the large iron and glass roof could be opened in fine summer weather. The girders of the roof proper are carried on wheels, which run on heavy longitudinal girders carried on the columns of the building. These girders extend beyond the roof, outside each end of the building, half the roof rolling to one end and the other half to the other end.

STREET RAILWAY CARS.

In London the street railway cars are large, and usually have seats on the top. As a rule, overcrowding is not allowed, so that the actual load does not often exceed that of a New York car packed to the steps. On some of the London cars the top seats are arranged transversely, with a gangway down the middle. In Paris the number of passengers is kept to the legal limit. When the car is full the conductor displays a sign to that effect. Passengers waiting at one of the little waiting rooms take each a ticket numbered consecutively; when the car comes up the conductor calls out the numbers, and those holding them can enter; if there is not room for all, those with the higher numbers must wait for the next car. The cars are noisy, and the rattling of the windows stops conversation. On some of the cars the driver has an elevated seat like the driver of a stage; such cars are turned on a turntable at the end of the line. In Brussels and Antwerp the cars are very small, usually with one horse. One line at Brussels has cars with five wheels. The four ordinary wheels have plain tires, and a smaller wheel has a flanged tire; this wheel can be raised and lowered by the driver, and the car can turn off the track when necessary, and cross streets where rails are not permitted to be laid. In Antwerp the cars have iron plate frames. The platforms are longer than ordinary; some cars having an outside seat for one person on each side of each platform, and some for two persons each. In Exeter (England) some of the cars have long platforms with outside seats, and steps on one side only.

HEAVY RAILS FOR CANADA.

Mr. C. T. SANDBERG, the designer of the "Goliath" flange rail weighing 100 lbs. per yd., has informed me that his 100-lb. rail has been adopted by the Grand Trunk Ry. of Canada for the St. Clair tunnel. The tie-plate will not be used on account of the difficulty of shimming. The joint ties will be 9½ ins. apart in the clear, the joints being suspended. Heavy angle splice bars are to be used, with four bolts, and two spikes through the flange of each bar.

E. E. R. T.

Notes and Queries.

A. Z. asks: When hauling is let by the ton, and neither long nor short ton specified, which is ordinarily understood?

[The short ton by the man who hauls; the long ton by the man who pays for it. There is no "ordinary understanding" which can be said to govern. The legal in most of the States is 2,000, but 2,240 lb. tons are by custom largely used. For example, coal is usually wholesaled by the long ton, and retailed by the short ton.]

CORRESPONDENCE.

A Sewerage Question.

TROY, O., July 22, 1890.

TO THE EDITOR OF ENGINEERING NEWS:

SIR: I have made plans and profile of a sewer leading from the County Infirmary to the Miami River, which runs through the city of Troy. As the sewer emptied about one-half mile above the city. I supposed I was safe from any hinderance, as the river water is not used for any city purposes; but the Board of Health prevented me from doing it, as they were of the opinion that it would contaminate the water in the city.

What is your opinion on the subject; and can you give me the name of some firm that deal in some device for consuming sewage?

R. F. WALKER,
City and County Engineer.

[We can in no case express opinions on questions of this nature, which depend largely on local conditions. There are various methods of sewage disposal described in treatises on that subject which may be appropriately used under such conditions. —ED. ENG. NEWS.]

Du Bois' "Strains in Framed Structures."

HOLDERVILLE, N. H., July 28, 1890.

TO THE EDITOR OF ENGINEERING NEWS:

SIR: In your review of "Strains" in ENGINEERING NEWS for July 26, it is stated just at the end that "the determination of maximum moments and reactions due to dead loads and locomotive wheels is undiscussed, as also is the economic lengths of shore, river and center spans. The importance of the subject certainly calls for its discussion." I do not know what to make of this statement. As to dead load, every book ever written treats that, and mine is no exception. As to wheels and economic lengths, it is stated in several places in the review itself that these topics are treated fully. Is there not a misprint somewhere, and do not you mean to say that "the determination of, etc., etc., is discussed" instead of "is undiscussed"?

A. J. DU BOIS.

[It seems to us that it should be clear from the context that the statement above quoted refers only to cantilever bridges; concerning other forms we gave due credit. The relative economic lengths of river, shore and center spans of cantilevers have been discussed by Mr. BENDER, and the subject of maximum moments and shears by Prof. MCMILLAN, but we find no mention of these questions in Prof. DU BOIS' volume.—ED. ENG. NEWS.]

Rapid Transit Subaqueous Tunnels.

READING, Pa., July 28, 1890.

TO THE EDITOR OF ENGINEERING NEWS:

SIR: In your article, "Rapid Transit Subaqueous Tunnels," ENGINEERING NEWS, July 19, it strikes me that your proof that steep approaches are in reality slower than more gentle ones, on the ground that passengers have further to travel on foot or by slow conveyances to reach the tunnel, is not just. A comparison on the grounds of *speed alone* should be made with *equal* distances between termini, and making the calculation for steep approaches and a distance of 6,500 ft. gives an average speed of 36.6 miles per hour against 27.3 miles per hour with gentle ones. But suppose the tunnel be only 3,400 ft. long, taking 62 sec. to traverse it. Then, increasing the surface velocity over the remaining 3,040 ft. to 16 miles instead of 8, a legitimate velocity, the time of making the trip of 6,500 ft. becomes 192 sec. against 161 for the longer tunnel, an *apparent* advantage for the latter, but not in reality such. The headway between trains will be equal to the time it takes to traverse the tunnel, or 62 sec. for the short one and 161 sec. for the longer. So a passenger arriving at the station just as a train has pulled out will be landed at the other extremity in 254 sec. by the short one against 322 sec. by the longer, a gain of half a minute. Also, as the carrying capacity depends on the headway between trains, that of the short tunnel will be just 2.6 times that of the other.

From these considerations, it seems to me that, aside from the *possible* disagreeable sensations produced by acquiring great speed in a short space, the advantages are all in favor of a tunnel with steep approaches.

S. W. FRESCOLN.

[The disagreeable sensations we do not regard as merely possible, but certain. There is no law of nature requiring that one train shall not be started until the one ahead has left the station. Trains can be stopped as easily when propelled by gravity as when propelled by any other motor, and as easily protected by signals, and occasions requiring a stop would be so rare that some secondary cable, only set in motion when needed, would cost practically nothing. This disposes of the otherwise strong objection advanced by our correspondent as to loss of capacity and loss of time of passengers by waiting for trains, leaving as a net loss from too steep grades the considerable ones noted in our article.—ED. ENG. NEWS.]

Local Engineering Societies.

CLARKSBURG, W. Va., July 31, 1890.

TO THE EDITOR OF ENGINEERING NEWS:

SIR: The letter of Mr. ALFRED P. BOLLER in regard to the reorganization of the American Society of Civil Engineers, and your own editorial remarks upon the "affiliation" question, affords some food for reflecting minds, both among the members of the American Society, *i. e.*, the "Sirs,"—and the "Maids."

I think there are many "frank, good-natured damsels" who will appreciate the wise and liberal spirit shown in the editorial to which reference is made. Many have long felt that there was no place for them in the National or American Society. Lacking a little of being qualified for *full membership*, they do not wish to be classified, as you remark, Mr. Editor, "among the boys,' and do not feel that the time has come "when membership in the American Society is a necessary passport for successfully practicing the profession of the civil engineer."

Mr. BOLLER is mistaken in believing that the American Society of Mechanical Engineers is the only scientific organization other than the American Society of Civil Engineers that requires anything more than "repectability and willingness to pay annual dues, as a qualification for membership. I may not have as extended acquaintance, as your correspondent just quoted, with the constitution and by-laws of the various local engineering societies, but I know of at least *one* society that requires something more than mere respectability and a bank account as qualifications for membership. The constitution and by-laws of the "Technical Society of the Pacific Coast" stipulate (Art. IX.):

Application for admission to the society shall be indorsed by three (3) members, who shall certify that they personally know the candidate, and that he is worthy of acceptance, Art. VI: A member shall be one qualified to design as well as direct technical work, and who shall have been engaged professionally in the practical application of science for a period of seven (7) years, or for a period of five (5) years if a graduate of a college or technical school.

The transactions of the society contain only original papers; those having never been read at the meeting of other societies or published in any form. Digests of recent publications of general technical interest are now invited from the members. It seems to me that it is indiscreet, to say the least, for the American Society or any of its members to say to the local engineering societies that "whatever standing they now have as engineers' associations they derive from members of the American Society" and that without them the local society could not live." This statement, coupled with the closing paragraph of Mr. BOLLER's letter, is un-American in its spirit and is sure to provoke antagonism. The present membership of the American Society will have to undergo a juster and better classification before even a majority of the local engineering societies will wish to be gathered together under the wings of a national society—its parent. I say this in all kindness, because I can—having no sour grapes to eat—and further, because I trust it may do some good and hasten the day when the American Society will be so organized that there will be a place for every worthy engineer and student, and every one may find his proper place.

BURR BASSELL.

[We did not and do not recommend that the American Society, as a society, shall say anything whatever to the local societies. Consulting any organized body as to the terms on which it will commit suicide is not likely to be productive of much good. What Mr. BOLLER did, and we indorsed, was to note the fact that the Am. Soc. C. E. membership is the bone and sinew of nearly all the local societies, which any one can see by looking over their lists of members; and then to urge that if the Am. Soc. C. E. would first reconstruct itself by going as far as it thought was proper to provide an acceptable grade for engineers of all varieties of experience, and to permit of local organizations within itself, it would then have done all that was necessary to ensure a gradual consolidation of scattered engineering societies into one body, and all that it was proper to do anyway. Addition of numbers should not be the end aimed at, but merely the adaptation of the National Society to all the needs which such a body could fulfill, letting the increase of numbers come or not, as it may.—ED. ENG. NEWS.]

Engineering News From Washington State.

FIDALGO CITY, Wash., July 27, 1890.

TO THE EDITOR OF ENGINEERING NEWS:

SIR: Being interested in engineering news (especially in the ENGINEERING NEWS), and seeing very little definite news as to what is being done in this section, I thought it might be of mutual benefit were I to write you occasionally as to what is transpiring in our profession.

I think it more than probable that this will be the banner State in railway construction in 1890. Also, there is, of course, a vast amount of engineering work of all kinds. I am in a new town where, in February was "primeval forest," but where we are rapidly carving out streets and making improvements. As I am Chief Engineer of the

Fidalgo City Improvement Co., of course I have a little of everything in the engineering line to do.

Let me give you a few items for you to use in any way you please. I shall confine myself to that part of the State of Washington which lies "West of the Mountains."

At the extreme south, the Portland & Puget Sound (U. P.) is building from Vancouver, Wash., to Tacoma and Seattle, via Olympia. They are at work at Vancouver, Olympia, Tacoma, and Seattle. They will have three terminals in Tacoma, at different points on Commencement Bay, having there, perhaps, better terminal facilities than any in the West.

The Northern Pacific is building to Gray's Harbor via Olympia (from Tacoma), and is "racing" with "HUNT'S Road," the Oregon & Washington Territory, which is also building to Gray's Harbor from Centralia. Each of these roads have about 2,000 men at work on their grade.

The Port Townsend Southern is at work all along the west side of Hood's Canal, and are also working in Olympia. The Port Townsend Southern is owned by the Oregon Improvement Co., of which ELIJAH SMITH is President, which company owns also the Seattle & Northern, building from Anacortes to the east, toward Spokane Falls.

The sale of the Seattle, Lake Shore & Eastern has been definitely announced, that road having become the property of the Northern Pacific, and we, Fidalgo Islanders, are working to bring the Northern to "the island," since both the N. P. and the Great Northern will be only 23 miles away from Fidalgo City or Anacortes, at Sedro, the N. P. having acquired the S., L. S. & E., as above mentioned, and the Great Northern having acquired the Fairhaven & Southern. The N. P. will finish, at once, the line to the British boundary, and the Great Northern is going ahead with the Fairhaven & Southern line to the boundary, both to connect with the Canadian Pacific.

Vice-President W. P. CLOUGH, of the Great Northern, President ELIJAH SMITH, of the Oregon Improvement Co. and JAMES MCNAUGHT, Chief Council of the Northern Pacific, are watched more closely, perhaps, just now, than any trio in the Union. They are spending much of their time in this part of "the Sound."

The Seattle & Northern is finished from Anacortes to Sedro, and the grade is finished to Hamilton, where are the great coal mines owned by the Oregon Improvement Co.

The Seattle, Lake Shore & Eastern track is laid to the Stillaguamish River. A number of miles are ready for the rails north of the river, and the bridge will be in place in a week. Parties of Great Northern engineers are exploring the passes at the head of the Skagit, notably the Skagit and Wenatchee passes.

The contract for the first 70 miles of the Seattle & Montana (Great Northern) was let last week to Shepard & Co., of St. Paul, who have built much of the Great Northern road.

Work has been begun and will be rushed forward as fast as men can be obtained.

This letter is already much too long, and I have only written of roads which are actually building.

D. P. SAUNDERSON.

[Our correspondent also encloses some further items as to electrical and other matters, which appear in their proper columns. There is certainly remarkable activity in Washington. We shall be obliged to him and to any other of our readers who can similarly favor us at any time.—ED. ENG. NEWS.]

An Improved Float.

We illustrate herewith a float which should be of interest to steam users, if all that is claimed for it is true, viz.: one made without soldering or brazing, and capable of working under high pressure without either collapsing or leaking. All steam users who have had experience with floats know how much trouble they incur in one way and another. The float illustrated is claimed to be reliable not only against any working pressure, but against leakage as well. It is the invention of Mr. A. J. WRIGHT, now president of the Reliance Gauge Co., of Cleveland, O., which manufactures them of all sizes and shapes, and for practically any pressure desired. Mr. WRIGHT having brought out the Reliance safety water columns, a thoroughly good device when supplied with good floats, it became necessary to either have a better float than that of ordinary construction, or to abandon the whole invention as worthless. After invoking in vain the aid of various metal workers and inventors, Mr. WRIGHT turned his personal attention to the subject, with the result in this illustration, which has proven entirely satisfactory.

To such a float as was desired three things were necessary. First, buoyancy; second, strength; and third, absence of soldering or brazing or other application of fire, which draws the temper of the metal. A float having these requisites cannot be made under the ordinary process, or any of the numerous variations attending it, hence this float is a radical departure from the usual construction in every respect. The principle on which it is constructed is very simple and will, we think, be easily understood by the sectional cuts which accompany this article. They are made of two spherical overlapping parts joined together over an inner band provided with internal flanges, to give strength and furnish shoulders for the joint.

Fig. 1 of the engraving shows the parts before being put together. Fig. 2 gives a cross section of the

FIG. 1.

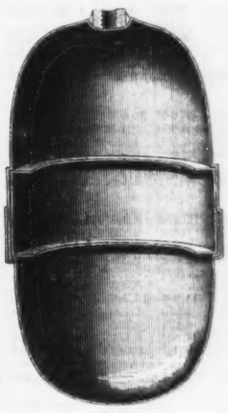

FIG. 2

float after having been put together, and the general appearance of the floats complete can be readily inferred from it.

Fig. 3 is an exact illustration of 7-in. floats which the Reliance Gauge Co. has been furnishing to Messrs. Watson & McDaniel, of Philadelphia, for steam traps furnished to the United States Government, used at an average pressure of 240 lbs. per sq. in. Similar floats 12 ins. in diameter, have been furnished to the Barr Pumping Engine Co., of Philadelphia, to work under 175 lbs. pressure. These 12-in. floats weigh only 15 lbs. and have 15 lbs. buoyancy, and have been in operation something over six months.

FIG. 3.

Improved Float, Reliance Gauge Co.

The floats shown in Figs. 1 and 2 are such as are used in the Reliance safety water columns, of which we are told that there are over 15,000 in use, some of which have been in operation for over five years without occasioning any trouble whatever. As they have withstood the test of actual use for this time, it is not unreasonably assumed that they are permanently reliable.

The manufacturers have also been furnishing these floats to various other parties, and they are regarded as in all respects successful.

A STEAM LIFE BOAT, built by Messrs. GREEN, of Blackwall, England, is described as follows by the London *Standard:*

The new craft is designed on a similar plan to the ordinary boats of the Royal National Lifeboat Institution, and is built of steel, with 15 water-tight compartments. The boiler and engine rooms are brought up about 3 ft. above the main deck, and are closed by iron covers to the manholes, air being supplied by forced draught. The passengers' space is a square space abaft the engines, seated all round, and will hold about 30 persons. The mode of propulsion adopted is a turbine, taking in water through the bottom of the boat at its apex, and discharging the water when it has attained its maximum velocity through tubular orifices on each side. About 1 ton of water per second is discharged. The speed at which the vessel ran on her trial trip was over 8 knots. From full speed ahead the vessel can be brought up in 32 seconds, and way can be got on her again in 4 seconds. She carries a mast with some sail power forward, the mast being lowered when needful. The new life boat has been named after the President of the Institution, *The Duke of Northumberland*, and will be stationed at Harwich.

THE DISASTROUS CONFLAGRATION AT WALLACK, IDAHO, noted last week, was merely what might have been expected in a town where the buildings were mere tinder boxes and the only water supply was by 2-in. mains drawing water from a reservoir which was emptied in 10 minutes. In the rebuilding of the town new water-works of ample size will be put in.

THE PROPOSED SUBMARINE TUNNEL between Staten Island and Long Island, mentioned in our issue of July 12, seems to be making good progress. A company has been incorporated and a route surveyed for the connecting road, which will be a branch of the Staten Island Rapid Transit Railway. The high backbone of Staten Island will be crossed by the pass known as Little Clove, and the tunnel will begin near Fort Wadsworth. On the opposite side the tunnel will emerge near Bay Ridge. The depth beneath the bed of the river will be about 35 ft., and the total length of the tunnel would be about 1¾ miles. So far as known, the tunnel will pass for the whole distance through a soft and easily worked soapstone.

AN ACCIDENT AT THE SAULT STE. MARIE CANAL on July 31 necessitated its closing for 89 hours One of the large valves in the lock, moved by hydraulic power, was broken, making necessary the pumping out of the lock before the damage could be repaired. A fleet of 150 vessels collected above and below the canal, and the total loss to vessel owners for even the short delay amounted to over $100,000. The docks can not catch up with the traffic for over two weeks. The incident well illustrates the urgent need of hastening the work on the new locks.

ELECTRIC DRILLS are in successful use at the Brooklyn Navy Yard. The box containing the drill is about 18 ins. long and contains only the motor and a coil of wire for connections. The motor runs at a speed of 2,800 revolutions per minute, but is geared down so that the speed of the drill is comparatively low. An inch hole can be bored through a half-inch iron plate in 30 seconds with one of the machines.

THE FIRST ELECTRIC EXECUTION, that of WM. KEMMLER, at Auburn, N. Y., on the morning of Aug. 6, seems to have been entirely successful in fact, but badly bungled in detail. The current was applied for 17 seconds and then stopped. The body shortly showed some convulsive movements, and it was assumed, whether truly or not, that it was not yet dead. The current was then turned on again and continued so long that the body was somewhat burned where the electrodes were applied. By a singular and somewhat suspicious oversight, the current was not nearly what was intended, if the press reports are correct. Nominally of 1,700 volts, nearly 1,000 volts was consumed by lamps which should have been switched out but were not, leaving only 700 volts to cause death, of which at least 15 per cent. was lost by imperfect contact of the electrodes and the natural resistance at the point of contact. While the execution seems, in spite of these mischances, to have been far quicker and more merciful than by hanging, the unfamiliar horrors appeal to public imagination as familiar ones do not, and there is likely to be great pressure to have this execution "the first and the last" by electricity.

AN ANNUAL INDEX OF TECHNICAL LITERATURE, embracing all books and journals on technical subjects published in the English, French and German languages, has been started by Herr M. SZCZEPANSKI, of Leipsic, Germany. The International News Co., of New York, are the general agents for the United States. The subscription price is 60 cents

TABLE SHOWING COST OF PRODUCING DIFFERENT GRADES OF IRON THROUGHOUT THE UNITED STATES.

ITEMS OF COST.	Charcoal Iron.			Anthracite Pig Iron			Coke Bessemer Pig.				Coke Iron.				Coke Pig Iron.			Southern Pig Iron.				
	Hot Blast.	Cold Blast.	So. H. B.	Bess. Pig.	Foundry.	Gray Forge.	No 1.	No. 2.	No. 3.	No. 4.	Foundry and Bessemer.	Found y.	Gray Forge.		No. 1.	No. 2.	No. 3.	No. 1.	No. 2.	No. 3.	No. 4.	No. 5.
Days run	344	248	333	365	167	181	171	288	310	365	360	233	365		340	366	357	344	365	365	365	338
Product, tons	24,945	2,500	14,396	43,800	8,297	22,931	25,303	32,870	30,000	30,392	32,417	18,614	24,867	57,100	39,985	36,479	32,660	35,158	41,272	61,133	39,997	11,855
Product per day, tons	73	10	41	120	50	127	148	114	97	83	140		107	156	118	100	91	102	113	168	109	35
Proportion of material per ton of product in tons:																						
Ore	1.617	2.944	2.257	1.820	2.447	1.509	1.380	1.507	1.600	1.621	1.590	1.634	1.582	1.698	1.686	1.294	1.237	2.128	1.964	2.952	2.328	2.192
Cinder						0.493	0.116	0.136			0.150	0.150	0.290	0.615		0.478	0.388					
Limestone	0.077	0.440	0.233	0.488	0.587	0.576	0.330	0.600	0.534	0.308	0.460	0.400	0.333	0.557	0.440	0.981	0.475	0.694	1.044		1.005	0.929
Coke				0.446	0.893	0.302	0.879	1.127	1.101	0.856	1.110	1.109	1.178	1.169	1.197	1.373	1.178	1.150	1.403	1.513	1.118	1.463
Charcoal	0.905	2.070	0.942																			
Coal				0.500	0.656	1.086		0.057	0.089	0.132				0.012	0.011							
Cost of material per ton:																						
Ore	$2.478	$2 900	$0.878	$4.950	$1.886	$5.854	$6.089	$5.626	$7.00	$5.371	$3.387	$4.771	$4.102	$5.024	$4.464	$5.535	$4 645	$1.570	$0.841	$1.686	$2.016	$1 867
Cinder						1.572	5.968	2.469			2.146	2.146	2.355	2 819		2.948	2.594					
Limestone	2 239	0.750	1.010	1.008	0.800	0.850	1.006	1.039	0.750	0.788	1.062	1.062	1.336	0.740	0.662	0.838	0.814	0.605	0.755		0.700	0.830
Coke				3.920	4.368	4.480	2.922	2.979	3.360	2.786	4.012	4.012	4.767	2.707	2.782	1.533	2.746	3.998	2.545	2.564	2.699	3.074
Charcoal	9.993	5.600	5.881																			
Coal				3.450	3.500	3.00		1.488	1.120	2.470				1.121	2.406							
Cost of material per ton of iron:																						
Ore	4.007	8.538	1.981	9.009	4.615	8.835	8.404	8.984	11.200	8.709	5.418	7.795	6.487	5.517	7 525	7.160	5.745	3.340	1.652	4.977	4.694	4.093
Cinder						0.775	0.697	0.336			0.322	0.322	0.684	1.732		1.410	1.007					
Limestone	0.173	0.330	0.235	0.491	0.409	0.489	0.322	0.623	0.400	0.243	0.425	0.425	0.448	0.412	0.295	0.827	0.386	0.365	0.789		0.704	0.771
Coke				1.750	3.900	1.354	2.568	3.354	3.700	2.384	4.451	4.451	5.616	3.165	3.331	2.105	3.234	4.600	3.572	3.878	3.016	4.498
Charcoal	9.043	11.589	5.541																			
Coal				1.725	2.276	3.250		0.085	0.100	0.327				0.014	0.026							
Total cost of material	13 223	20 459	7.757	12.975	11.260	14.712	11.991	13.386	15.400	11.693	10.616	12.903	13.235	10.840	11.147	11.502	10.372	8.305	6.013	3.855	8.414	9.362
Labor	1.194	2.932	1.461	1.250	2.069	1.300	0.975	1.490	1.500	1.364	1.234	1.234	1.707	1.315	1.106	1.242	1.404	1.964	1.663	0.784	1.389	1.311
Officials and clerks	0.261	0.880	0.528	0.091	0.464	0.274	0.134	0.136	0.317	0.182	0.131	0 131	0.121	0.110	0.207	0.165	0.159	0 173	0.420	0.049	0.150	0.435
Supplies and repairs	0 480	0.920	0.498	0 500	0.304	0.645	0.403	0.484	0.550	0.208	0.161	0.161	0.198	0.290	0.281	0.235	0.464	0.837	0.400	0.290	0.501	0.675
Taxes	0.044	0.060	0.035	0.028	0.024	0.022	0.081	0.039	0.019	0.016	0.035	0.035	0.063	0.013	0.019	0.027	0.025	0.031	0.057	0.047	0.028	0.042
Total cost	$15.202	$25.249	$10.279	$14.844	$14.121	$16 953	$13.584	$15.535	$17.786	$13.433	$12.177	$14.554	$15.324	$12.568	$12.820	$13.111	$12,424	$11 310	$8,553	$10.025	$10 48.	$11.825

The Cost of American Pig Iron.

In a recent number of the *Iron Age* is a review of the report of Mr. C. D. WRIGHT, U. S. Commissioner of Labor, on the production of pig iron in the United States, based on returns from over 100 furnace From this article the accompanying table and note. have been compiled.

It appears that the average cost of producing a ton of charcoal iron is $15.20; anthracite pig costs $15 on an average; coke Bessemer pig, $14.75; coke foundry and forge iron, $13.68; coke pig iron, $13.82. The above figures do not include Southern plants. The average cost of producing a ton of pig iron in the Southern districts, as determined from 18 furnaces in Alabama, Tennessee, Virginia and Georgia is $10.79.

Under the charcoal irons, the first furnace is interesting as an example of a plant possessing rich and cheap ore, counterbalanced, however, by costly charcoal. The ore of the third furnace, although lean, is extremely cheap, the charcoal is very low, and labor, supplies and repairs below the average. The locality is one enjoying an exceptional coincidence of favorable conditions.

Among the anthracite furnaces, the last is interesting on account of the great amount of fuel used. Its low cost, however, indicates that the plant is near the coal regions.

Among the coke Bessemer pig furnaces, the first is notably a low consumption of fuel, a fairly cheap ore and a very low labor account. The third produces a low phosphorus iron and evidently uses foreign ores.

Among the coke iron furnaces the first is particularly interesting. The furnace ran for part of the year on foundry iron and part on Bessemer pig; the first series of figures giving the cost for the foundry iron. Except in regard to the cost of ore, the figures are nearly identical. It will be noticed that the furnace is located near the ore, but distant from the fuel. The second furnace has both high ore and fuel to contend against, and in spite of a fair capacity has high labor. The third furnace, with high cost of ore, uses cinder largely, and, with cheap coke aiding it, produces a fairly cheap forge iron.

The coke pig iron furnaces are led by the first, which has both cheap fuel and a low labor cost. The second uses such a cheap coke that it is probably located near the fuel, but a high cost of ore, although cinder is used, renders the metal somewhat dear. The iron from the third furnace, which also uses cinder, is somewhat cheaper.

The table of Southern furnaces is particularly interesting. No. 1 uses a high grade coke, paying a round sum for it, but thereby gaining a low fuel consumption and a pretty good product. No. 2 is clearly in the Birmingham district, where ore is cheap, but calls for heavy lime charges. No. 3 has apparently a self-fluxing mixture, no limestone being reported; the ore, however, is exceptionally lean, yielding little more than 33%. No. 4 is a large furnace with lean and dear ore, moderately cheap coke and average labor. No. 5 is a good example of a small furnace.

In the tabular statements of cost, interest, insurance, depreciation of value of plant and charges for freight on product to place of free delivery are not included. In the case of the Southern ores, the last named item is very heavy.

CONSTRUCTION NEWS.

RAILWAYS.

EAST OF CHICAGO—Existing Roads.

Wabash.—The Peru & Detroit Railway, extending from Peru, Ind., to Chili, on the Detroit division of the Wabash, will be finished about Sept. 1. The Wabash will locate a round-house and shops at Chili. It is stated that the company will enter Pittsburg as soon as the Pittsburg, Akron & Western is completed.

Dutchess County.—This railway is under construction from the east terminus of the Poughkeepsie Bridge to Hopewell Jc., N. Y., and surveys are in progress for an extension to Lake Mahopac to connect with the New York & Northern or the Harlem Railroad.

Great Eastern.—Ballasting is nearly completed between Nicolet and St. Gregoire, P. Q. The Drummond County Railway will soon put on a regular train service between Drummondville and Nicolet.

Cumberland Valley.—President Thos. B. Kennedy is quoted as follows, concerning the proposed extension of this road in Southern Pennsylvania:

"The Cumberland Valley R. R. Company is running a line westward, and when the line is completed, the maps are made and the estimates of the cost of construction are given, it will be determined whether or not the new road will be built. Our last survey commenced south of the Western Maryland R. R. crossing, runs west, near St. Thomas to Fort London, thence to the base of the mountains, at Gowan's Gap. If that line should be adopted the mountain at that point would be tunneled."

Shepaug, Litchfield & Northern.—W. J. Smith, of Waterbury is making surveys for the proposed six-mile extension from Litchfield to Torrington Conn.

Elmira, Cortland & Northern.—A party in charge of Mortimer Rickey has just completed the preliminary survey for the extension from Camden to Watertown, N. Y., 50 miles. The line surveyed runs from Smithville to Lellville over the abandoned grade of the Sackett's Harbor & Ellisburg Ry. Grades will be very easy and the work light. There will be a 250-ft. bridge over the Salmon River.

Baltimore & Eastern Shore.—This line from Vienna, Md., to Bay Shore, 45 miles, was opened for traffic July 29. The grading is completed from Salisbury to the Nanticoke River, and tracklaying is in progress. The Nanticoke bridge will be finished in about a month.

Middletown & Hummelstown.—The last spike was driven on this Pennsylvania road on Aug. 1 by General Manager Joseph Campbell.

Chicago & Atlantic.—The sale of this road will take place on Aug. 12 at Indianapolis. Reports have been in circulation that several rival interests would put in bids for the property. It is now stated, however, that there is no likelihood of any one but the Erie purchasing the road.

Midland (Indiana).—Right of way is being purchased from the end of the old grade to the junction with the Vandalia line, and work is in progress putting the old grade in shape along the line.

Canadian Pacific.—An attempt is being made to have the Elora branch extended to Stratford, via Elmira, St. Clements, and Wellesley.

Herkimer, Newport & Poland.—Parties represented by R. W. Leonard & Co., of New York, have purchased a majority of the stock of this narrow gauge New York road. The purchasers agree to widen the gauge of the road and extended it from Poland to Jock's Lake, about 30 miles, within a year. Surveys for the extension are reported in progress.

Pittsburg, Shenango & Lake Erie.—The controlling interest in this Pennsylvania road, whose completion has been delayed by years of litigation and dissensions among the owners, has been purchased by Frederick Huidekoper and Samuel Dick, of Meadville, Pa. It is stated that the road will at once be completed from Greenville to Conneaut Harbor.

Clarendon & Pittsford.—Right of way is being obtained for the extension of this Vermont road.

Baltimore & Ohio.—It is reported that the Bellaire, Zanesville & Cincinnati and the Columbus, Lima & Northwestern railways, in Ohio, have been acquired by this company.——Right of way is being obtained for the Metropolitan Southern Railroad, which is to run from Linden station, on the Metropolitan branch of the B. & O., to Great Falls, on the Potomac, where a bridge will be built and connection will be made with the Richmond Terminal system.

Cleveland, Cincinnati, Chicago & St. Louis.—A good part of the right of way for the extension from Springfield, O., to Columbus has been secured, and contracts will be ready for letting within a few weeks. The distance is about 40 miles. Tracklaying is almost done on the extension of the Cincinnati, Wabash & Michigan from Anderson to Rushville, Ind.——Branches are projected on the White Water R. R. from Laurel west to stone quarries, 5 miles, and from Beeson toward Richmond, 19 miles.

Pennsylvania.—On Aug. 1 the company paid the last instalment on account of the purchase of the main line from the State of Pennsylvania, $635,654.94. The purchase was made in 1857.——The consolidation of the Pittsburg, Cincinnati & St. Louis, Chicago, St. Louis & Pittsburg, Cincinnati & Richmond, and Jeffersonville, Madison & Indianapolis companies is to be considered at a stock-

holders' meeting at Columbus, Aug. 19.—It is reported that a line will be built from Reading to Allentown, Pa.

New York & New England.—This company has secured control of the Providence & Springfield R. R., and will extend it 7¾ miles to connect with the N. Y. & N. E. main line. This will give the company a direct route to Providence from the west.

Louisville, Evansville & St. Louis.—Surveys have been ordered for an extension from Marengo, Ind., to French Lick Springs.

Concord & Montreal.—The extension of the Penrigewasset Valley R. R. in the White Mountains is being canvassed.

Perry County.—An extension is projected from New Bloomfield to Loysville, Pa.

Wheeling & Lake Erie.—Tracklaying has begun on the extension from Portland to Steubenville, O. Grading will soon begin between Portland and Martin's Ferry.

Projects and Surveys.

Skowhegan & Norridgewock.—We are indebted to Mr. Frederic Danforth, who has just completed surveys for this Maine road, for the following information:

A preliminary survey has been made from Skowhegan, on the Maine Central, to Norridgewock, on the Somerset Ry., 5¼ miles. No company to build the line has yet been formed, the expense of the survey being met by a private subscription.

Plymouth & Middleboro.—A new survey for this Massachusetts road has just been made. Jas. M. Hodge, of Plymouth, is Chief Engineer, and T. D. Shumway is President.

Buffalo, Thousand Islands & Pacific.—This company has obtained most of the right of way for its line through Niagara Falls, Suspension Bridge, Wheatfield and Tonawanda. The company will build from Niagara Falls to a connection with the Rome, Watertown & Ogdensburg. Surveys are now in progress. F. A. Becker is Chief Engineer.

Tunkhannock & Lanesboro.—Press reports state that a railroad is projected between these two Pennsylvania towns. The distance is about 40 miles.

Saltsbury & West Lebanon.—Chartered in Pennsylvania, Aug. 1, to build a railway between points named, a distance of 12 miles.

Holland South Shore.—Organized at Holland, Mich., to build a railway along the south shore of Black Lake. Wm. H. Beach is President and Geo. P. Hummer, Secretary.

Delhi & Arkville.—The old project for a railway between these towns in eastern New York has been revived. The old charter of the Delhi & Middletown Co., which was organized to build over this route, expires in November.

Toledo & Western.—The Cleveland *Leader* states that the financial backing of this scheme has not materialized, and that the projectors are about selling out their scheme to the Norfolk & Western. The latter part of the story, at least, is very improbable.

Toronto, Hamilton & Buffalo.—Some work is in progress obtaining right of way near Hamilton for this Canadian road and grading is to begin very soon. E. B. Wingate, of Hamilton, is Chief Engineer.

Pennsylvania, Lehigh & Eastern.—At a meeting of the stockholders at Wilkesbarre, Pa., Aug. 5, Jos. Pool of New York, was elected President and S. P. Wolverton, of Sunbury, Elias Lowenstein, of Wilkesbarre, and others, directors. The proposed line is to run from Tomhicken to Port Jervis.

Bowmansdale & Southern.—A railway is projected in York Co., Pa., to run from Bowmansdale on the Philadelphia & Reading to Porter's Siding, on the Western Maryland. The cost of the line is set at $400,000.

SOUTHERN.—Existing Roads.

Monongahela River.—The first train on this West Virginia road from Fairmount to Clarksburg was run on Aug. 4.

Rutledge & Julian.—This short Alabama road will be finished in a few weeks.

Chesapeake & Ohio.—The *Railroad Gazette* says that Howard & Sears, who have the contract for the Craig Mineral Ry., have sublet the grading on 10 miles to J. C Carpenter, 3 miles to Reinhart and Teaford, 3 miles to Gooch & Waugh, and 3 miles to Rheinhart & Patton. The masonry has all been let to Rozazza & Moltini.

Walterboro & Yemassee.—J. J. Cummings, of Port Royal, has the contract for building this road from Yemassee to Pregnall's, on the South Carolina Ry., 40 miles. Gordon Gairdner, of Augusta, Ga., is Chief Engineer.

Georgia Pacific.—Tracklaying has been completed from North Birmingham to Coalburg, 7 miles. The contract has been let for 7 miles of double track between Atlanta and Peyton.

Morristown & Cumberland Gap.—Allison, Shafer & Co., of Chattanooga, are reported to have the contract for building this road from Morristown to a junction with the Knoxville, Cumberland Gap & Louisville road near Luttrell. The road is backed by the K., C. G. & L. Co. J. G. Martin, of Asheville, N. C., is President.

Lynchburg Belt.—Surveys are in progress for the last link in this line connecting the Norfolk & Western and Lynchburg & Durham roads at Lynchburg.

Atlantic Coast Line.—The extension of the Manchester & Augusta Railway from the Santee River to Augusta, 94 miles, is being canvassed. The line was located three years ago, but nothing has been done on the grading. Officers of the company are quoted as saying that if Augusta will grant the privileges asked, the road will be built within a year.

Chattanooga Southern.—On Drew, Armstrong & Co.'s contract for 35 miles, 15 miles are graded and 6 miles of track are laid, and the whole division will be completed in 60 days. The whole road will be ready for business about Nov. 15.

Kinniconick & Freestone.—The *Railway Age* says this road up Kinniconick creek in Lewis county, Ky., will be completed in 45 days. About 2 miles of track has been laid. The whole length will be 10 miles. E. P. Reynolds & Co., of Rock Island, have the contract. C. B. Houghton is President and W. B. Prather, of Garrison, Ky., is Chief Engineer.

Central R. R. of Georgia.—A survey is being made from Troy, Ala., south toward Pensacola, Fla., under direction of Capt. F. Y. Dabney.

Louisville Southern.—The viaduct just completed over Marble Creek on the Richmond, Nicholasville, Irvine & Beattyville is 211 ft. high. Tracklaying is about finished from Nicholasville to Versailles.

Ohio Valley.—It is reported that the company is negotiating for the purchase of the Louisville and Nashville branch from Princeton, Ky., to Clarksville, Tenn., and if unsuccessful will begin surveys at once to parallel that line.

Augusta & West Florida.—It is stated that this company will purchase the abandoned grade of the Carolina, Knoxville & Western, and the Louisville & Wadley R. R.

Projects and Surveys.

Charleston, Wilmington & Norfolk.—A reconnoisance for this proposed road is being made by Chief Engineer John Runk. A charter is soon to be secured in North Carolina. Philadelphia capital is said to be back of the enterprise.

Carolina, Greenville & Northern.—This road is proposed to extend from Paint Rock, N. C., to Kingsport, Va., about 54 miles. Greene Co. will vote about Oct. 1 on a $25,000 subsidy in aid of the enterprise.

Knoxville Western.—This is the name of the company which proposes to build from Cookeville to Big Creek, Tenn., whose incorporation was noted two weeks ago. C. O. Jenkins, of Cookeville, is interested.

Alabama, Georgia & Florida.—The projectors of this road are obtaining subscriptions to capital stock along the line and have two corps of engineers at work on the surveys.

Cumberland Gap & Mississippi Valley.—Jos. F. Foard has been elected President, and Hunter Wood, Secretary, of this Kentucky company. The projected line extends east and west across the State.

Cape Fear & Cincinnati.—The contract for building this road has been taken by the Massachusetts & Southern Construction Co. The total length of lines proposed is several hundred miles. John Wilson Brown is President, and George B. Morton, of Baltimore, is General Manager of the company.

Birmingham, Jackson & Kansas City.—Jackson, Tenn., has voted $65,000 to this company. Every town and county has now voted the full subscription asked, and it is expected that construction will soon begin.

Rosedale & Mississippi Central.—The Chief Engineer of this road is Mr. R. B. Eggleston, of Rosedale, instead of A. Gleson, as recently reported. Preliminary surveys have been made from Rosedale to Bogue Phalia River, which is a land-locked bayou, navigable for 50 miles. Mr. Eggleston writes us that the road will develop and give an outlet to one of the best sections of the Mississippi delta.

Charleston, Kentucky & Western.—The executive committee, composed of J. G. Spaulding, of New York; R. M. Nelson, of Newport; Major Bullock, of Falmouth; Dr. M. Dills, of Carlisle; James M. Bigstaff, Adam Baum and W. H. Trimble, of Mt. Sterling, met recently at Blue Lick Springs, and took steps for a preliminary survey, at the same time granting General Superintendent J. S. Spaulding power to make a contract for the construction of the road. This road is an air line from Mt. Sterling, Ky., to Newport, via Sharpsburg, Carlisle and Falmouth, a distance of 92 miles. The promoters have raised $25,000 to make the survey, and establish a permanent line. From Mt. Sterling this road goes on through to Clay City, Beattyville and Pound Gap.—*Ry. Review.*

Pittsburg & Virginia.—Press reports state that surveys have been made from Lexington, Va., to Pittsburg, Pa. Ex-Governor Fitzhugh Lee, of Virginia, is President of the company.

Grayson County.—A branch railway is to be built at once from Big Clifty, on the Newport News & Mississippi Valley Ry., to the asphalt deposits in Grayson County.

Camilla & Cheevertown.—Residents of Camilla, Ga., are agitating a railway to Cheevertown on Flint River, 20 miles.

Gadsden, Shelby & Montgomery.—The preliminary survey has been completed for this Alabama road between Gadsden and Montgomery, 160 miles. W. H. Denson, of Gadsden, and Chas. M. Shelby, of Birmingham, are at the head of the enterprise.

Bristol, Elizabethton & North Carolina.—It is reported that the Unaka Construction Co. has the contract for 60 miles of this road from Bristol, Pa., to Mountain City.

Atlanta & Birmingham.—A company by this name has been chartered in Georgia by B. H. Hill, Arthur Hutchison, E. M. Bialock and others.

NORTHWEST.—Existing Roads.

Chicago & Eastern Illinois.—The directors have agreed to build an extension from Tuscola to Shelbyville, Ill.

Burlington & Missouri River.—It is reported that a branch will be constructed from Superior, Neb., to Hayes Center and Dodge City, Kan.

Jacksonville Southeastern.—About 500 men are at work on the St. Louis extension, which is expected to be completed by Oct. 1. The iron rails on the main line are being replaced with steel.

Calgary & Edmonton.—About 12 miles are graded on this road, and over 1,000 men are at work between Calgary and Red Deer. Alex. Stewart, Calgary, Alberta, N. W. T., is Chief Engineer.

Chicago, Milwaukee & St. Paul.—A preliminary survey has just been completed from Chamberlain to Rapid City, So. Dak.

Chicago, St. Paul, Minneapolis & Omaha.—Charles Gleason has the contract for 22 miles of the Randolph, Neb., extension. The work is to be done by Oct. 1.

Kearney & Black Hills.—Tracklaying on his Nebraska road has been completed from Kearney northwest about 20 miles.

Salt Lake & Bountiful.—Grading has begun at the Salt Lake end of this Utah road, and work is to be pushed as fast as possible. H. S. Joseph is Chief Engineer.

Canadian Pacific.—This company has just guaranteed the payment of interest on $20,000,000 of bonds of the Duluth, South Shore & Atlantic Ry. and $10,000,000 of bonds of the Minneapolis, Sault. Ste. Marie & Atlantic Ry. On the Glenboro extension in Manitoba the grading contractors are actively at work.

Kansas City, Wyandotte & Northwestern.—It is reported that the Missouri Pacific has acquired a controling interest in this company and will build extensions in Nebraska from Carpendale to Oswego City and from Hastings to Crete.

Chicago, Fort Madison & Des Moines.—This company is negotiating for aid from Council Bluffs. It is said the road will be running from Ft. Madison to Ottumwa, Ia., before winter.

Wisconsin Central.—A branch 17 miles long will be built from Marshfield to Greenwood, Wis., and one about the same length from near Ceylon to near Turtle Lake.

East St. Louis, Chester & Grand Tower.—B. T. Johnson, of St. Louis, has the contract for 66 miles of this Illinois road, and will begin work at once.

Forest City & Sioux City.—This road, which has been delayed from lack of iron, is now completed to Forest City, So. Dak.

Pacific Short Line.—On July 31 the first division from Sioux City to O'Neill, Neb., was opened for traffic. The Missouri River is crossed on a pontoon bridge 2,600 ft. in length, built at a cost of $30,000. Grading is to be pushed at once on the extension from O'Neill west, according to President Donald McLean.

Chicago & Northwestern.—The annual report shows gross earnings of $27,164,837, an increase of 5.73% over the preceding year; operating expenses, $16,651,002, an increase of 8.65% over the preceding year, and net earnings, after paying interest on bonds and taxes, $4,070,965, an increase of $4,450 over the preceding year.

The extension from Whitewood to Deadwood, So. Dak., will be completed about Oct. 1, and from Buffalo Gap to Hot Springs about the same time. The contract for an extension from Metropolitan to Crystal Falls in the North Michigan peninsula, has been let to McArthur Bros. The company is securing right of way for an extension at Fond du Lac, Wis.

Projects and Surveys.

Lebanon, Mascoutah & Fayetteville.—This company has been organized in Illinois. Amoung those interested are Frank Perrin of Mascoutah, J. D. Baker of Lebanon, and Louis Burgard of Fayetteville.

Prince Albert, Hudson Bay & Pacific.—This company will apply to the Dominion parliament for incorporation. The projected line is to run from Hudson Bay to the Pacific Coast via Prince Albert, N. W. T.

Covington & Deadwood.—An "air line" railway is projected between these Dakota towns.

Quincy, Keokuk & Chicago.—This company is endeavoring to secure a stock subscription of $40,000 from the citizens of Nauvoo, Ill.

Iowa.—The following railway companies have been charteerd since June 30: Des Moines Suburban; Des Moines & Northern; Iowa & Nebraska; St. Louis, Quincy, Omaha & Sioux City; Chicago, Fort Madison & Des Moines; and the Albia & Centreville.

Sioux City Northwestern.—Preliminary surveys began on this road July 30 under direction of Edward Vincent. A. S. Garretson, of Sioux City, is President. The line is to run from Sioux City to the Black Hills.

Atlantic, Mexican & Pacific.—Incorporated in Illinois to build from the east State line to St. Louis. Press reports state that the projectors propose to build from Toledo, O., to Matanzas, on the west coast of Mexico, and are (of course) heavily backed by English capitalists. The only one of the incorporators who has been run to earth is S. M. Reynolds, of Terre Haute, Ind., who, natu-

rally enough, has been found to be superintendent of a gas company.

Manitoba & Southeastern.—Chief Engineer Alexander Stewart is making surveys for this road from Winnipeg to the international boundary line. The company is reported to be negotiating for the sale of its charter and land grant to the Duluth & Winnipeg.

Wisconsin Midland.—Surveys have begun again from Fond du Lac northward. It is again reported that the Illinois Central is backing the enterprise.

Winnipeg & Hudson Bay.—A party of explorers have started for Moose Factory, Hudson Bay, to investigate the reported mineral wealth along the line of this road.

SOUTHWEST. Existing Roads.

Denison, Bonham & New Orleans.—This Texas company, which owns a partially graded roadbed, is being reorganized and it is stated that the line will be built. J. P. Holmes, of Denison, is interested.

Weatherford, Mineral Wells & Northwestern.—Grading is in progress on this Texas road, and it is expected to complete it this fall.

Haines, Hamilton & Gulf.—The contract has been let for this Missouri road to run from Kingston to Hamilton, 8 miles. S. C. Rogers, of Kingston, is Chief Engineer.

Kansas City, Nevada & Fort Smith.—Grading is nearly completed on the 50-mile section between Grand View and Amorat in southeastern Missouri, and contracts for tracklaying are soon to be let.

Louisiana, Arkansas & Missouri.—The contract made with this company by the Tensas levee basin commission, a year ago, has been declared null and void. A new contract is to be entered into by which the company will be obliged to begin work at once.

Kansas City, Watkins & Gulf.—Grading is completed from Lake Charles north to within 30 miles of Alexandria.

San Antonio & Aransas Pass.—The receivers will apply to the court for permission to build a line closing the gap between Lott and Rockdale.

Sherman, Dallas & Denison.—Grading is in progress on this road near Sherman, Tex.

Kansas City, Arkansas & New Orleans.—This company has graded 40 miles of its road and will begin laying track at once.

Stuttgart & Arkansas River.—This Arkansas road is now finished from Stuttgart to Almyra, 12 miles. The track will reach DeWitt about Sept 1.

Projects and Surveys.

St. Joseph & Northwestern.—Chartered in Missouri to build from a point on the Chicago, St. Paul & Kansas City in Andrew Co. to the Iowa State line, about 60 miles. Jas. Craig, Jr., is interested.

Kansas City, Lawrence & Nebraska.—The directors have voted to build the road on the original survey made three years ago.

Midway.—Incorporated in Kansas by E. H. Brown, of Girard, and others, to build from Litchfield to the Missouri State line, a distance of 2 miles.

Rio Grande.—This Texas road has completed the survey from Comanche to Llano.

ROCKY MT. AND PACIFIC.—Existing Roads.

Rio Grande Southern.—C. W. Gibbs of Dallas, Col., Chief Engineer of this Colorado road, sends us the following information:

This railway is to run from Dallas to Durango, Col., 160 miles, via Placerville, Telluride, and Rico. The line is all located from Dallas to Rico, 65 miles, and from Durango for 45 miles. Right of way is all secured through Ouray, San Miguel, and Dolores counties, and from Durango for 40 miles. The only local aid secured is part of the right of way in Dolores and San Miguel counties. Carliles & Weisbrec of Pueblo, Col., the contractors, have about 2,000 men at work and have 35 miles graded. About eight miles of rails have been laid and tracklaying will recommence Aug. 10. The first 15 miles will open for traffic Aug. 15, and by Nov. 1 it is expected to have trains running from Dallas to Rico. The maximum grades on the line are 4% for eight miles, the balance 3% with maximum over some divides of 2½%. The maximum curvature is 20°. The most important bridge is a 202 ft. deck span 142 ft. in height over Pleasant Valley creek.

Arizona Central.—It is reported that this Arizona road will be built from Flagstaff to Phœnix this fall.

Pecos River.—About 200 men are at work on this New Mexico road, and 300 more are to be put on at once. About 25 miles of road are graded and 12 miles of track are laid.

Silver City, Pinos Altos & Mogallons.—The funds are reported raised for building this New Mexico road Wm. H. Newcomb, of Silver City, N. M., is President.

Washington.—A letter in our correspondence column from David P. Sanderson, City Engineer of Fidalgo City, Wash., gives an interesting account of the progress of work in this State.

Union Pacific.—The Utah & Northern will be widened to standard gauge by Oct. 1. A great deal of work is being expended to improve the line and grades and upon the roadway.—About 100 miles are graded on the Milford and Pioche extension, and tracklaying is to begin soon. The whole line will be completed before winter, but when it will be extended beyond Pioche is still undetermined.—Work is in progress near Chehalis, Wash., on surveys and right of way.—The extension of the Denver, Texas & Fort Worth division from Maxwell, Col., to Pels, 9 miles, has been opened for traffic.

Atchison, Topeka & Santa Fe.—The old rumor that the company intends to build an extension to San Francisco has been revived.—The extension to San Pedro, N. M., will not be begun before the last of September.—Surveys are in progress for a cut off near Las Vegas, Hot Springs, N. M., which will bring that town on the main line.

Great Northern.—This company has secured control of the Fairhaven & Southern R. R. in Washington. Rails have just arrived sufficient to iron the road from Westminster to Blaine. Trains are now running on the first section of 26 miles. The Seattle & Montana Ry. has been incorporated in the Great Northern interest, and the contract for building 77 miles of road from Seattle north to the Fairhaven & Southern has been let to Shepard & Co., of St. Paul, Minn. The contract requires the whole line to be ready for the rails by Nov. 1, and the tracklaying must be completed by Dec. 1. The San Francisco Bridge Co. has the contract for the bridges and trestles on the line. Work is in progress on the surveys and right of way for an extension from Seattle to Portland, paralleling the Northern Pacific line. The line from Assiniboine, Mont., west has been located for 108 miles, and contracts for the construction of this section are to be let at once.

Spokane Falls & Northern.—This road has been completed from Spokane Falls to Little Dalles, where connection is made with steamers on the Columbia River.

Southern Pacific.—The company has agreed to complete the coast line between Santa Margarita and Ellwood in consideration of the $315,000 subsidy raised by the coast counties through which the line will pass.

Seattle & Northern.—Track has been laid to Hamilton, making about 35 miles of the line completed.

Bellingham Bay & British Columbia.—Contracts are reported closed for the last link of 10 miles connecting this road with the Canadian Pacific.

Northern Pacific.—About 40 miles of the Mullan branch have been turned over to the company by the contractors.—Between 2,000 and 3,000 men are at work on the Missoula cut off; only 40 miles remain to be built. It is expected the whole line will be ready for traffic in November.—The Elkhorn branch is now in the hands of the operating department.—The Tacoma, Olympia & Gray's Harbor road is to be rapidly pushed by about 1,800 men and 500 teams. All the contracts are let and part of the track is laid. The total length to be built is about 100 miles. The extension from Chehalis to South Bend, Wash., is to be built by Webster, Kelso & Dare.

Projects and Surveys.

Butte, National Park & Southeastern.—At a meeting held at Butte, Mont., July 28, Lee Manthe was elected President and N. C. Ray, Chief Engineer. The preliminary survey was approved and it was voted to proceed at once with the locating surveys. The headquarters are to remain at Butte.

Coos Bay, Coquille & Coast.—It is reported that grading began Aug. 1 on this Oregon road. C. B. Power, of Marshfield, Ore., is interested.

Rio Grande & Salt Lake.—Price & Gavitt, of Denver, have the contract for building this road from Algodones, N. M., to Durango, Col. V. D. Simar is Chief Engineer. The headquarters of the company are to be at Santa Fe N. M.

FOREIGN.

Matamoras, Matehuela & Pacific.—The contract for building this proposed Mexican road has been let to W. S. Robertson. W. D. Brittain is General Manager. The road is proposed to extend from Matamoras on the Rio Grande to San Blas on the Pacific coast.

Mexican National.—It is reported that this line will be changed to standard gauge.

CITY TRANSIT.

Elevated Railway.—***Brooklyn, N. Y.***—The Union Elevated R. R. will build new shops at Broadway and Manhattan Junction. Two new coaling stations will also be built.

Horse Railways.—***Proposed*** at Washington, D. C. Address C. M. Heaton, East St. Louis, Ill.; Galveston, Tex.; Houston, Tex.

Extensions are contemplated at Carthage, Mo.

Meriden, Miss.—Beard & Brandon are surveying a belt line for the city and building a dummy line to Bonita.

Dummy Railway.—***Mt. Tabor, Ore.***—Surveys are being made.

Electric Railways.—***Proposed*** between Milleville and Bridgeton, N. J.; at McKeesport and West Chester, Pa.; Lynchburg, Va.; Chattanooga, Tenn.; Raleigh, N. C.; between Denver and Manchester, Col.

Extensions will be made at East Cleveland, O.; Terre Haute, Ind.; Knoxville, Tenn.; Minneapolis, Minn.; Tacoma and Seattle, Wash.

Brooklyn, N. Y.—The injunction restraining the Brooklyn & Jamaica R. R. from using electricity has been dissolved.

Orange, N. J.—The Newark Passenger R. R. Co. has been granted permission to use the overhead trolley on its Orange lines. The company is obliged to introduce improvements on its lines in that city as soon as in Newark and must provide five 16 c. p. lamps on every other pole.

Champaign, Ill.—Electricity will replace horses.

Walla Walla, Wash.—A line will be built to Free. water 10 miles distant. Power to be furnished by turbines using water from the Walla Walla River.

Fidalgo City, Wash.—Final surveys for a line to Anacortes, 11 miles distant, are being made by D. P. Sanderson. All contracts have been let.

New Companies.—Chicago & Lake Shore Electric Ry.; incorporators, C. H. Renny, G. O. Fairbanks, F. L. Brooks; capital stock, $1,000,000. Robberson Ave. Ry., Springfield, Mo.; incorporators, F. S. Hefferman, M. J. Hubble, A. Hefferman; capital stock, $50,000.

HIGHWAYS.

New York.—A 14 mile highway will be built between Patchogue and Port Jefferson, Long Island.

Ohio.—Surveys for 7 miles of new macadam roads are being made near Barnesville.

Washington.—The commissioners of Whatcom Co. have under discussion the building of 100 miles of gravel and plank roads.

BRIDGES, TUNNELS AND CANALS.

Bridges.—***Chicopee, Mass.***—A bridge will be built across the Connecticut River.

Niantic, Conn.—The New York, New Haven & Hartford, has begun a $200,000 draw-bridge at this point.

Hadley, N. Y.—Another attempt will soon be made to build a bridge over the Sacandaga.

New York, N. Y.—Jacob Lorillard and his associate commissioners are securing the land for approaches to the new Harlem bridge.

Pittsburgh, Pa.—An ordinance has been passed authorizing the South Side Bridge Co. to build a bridge across the Monongahela.

Harper's Ferry, Va.—The Harper's Ferry & Loudoun Bridge Co. will rebuild the bridge washed away in June, 1889.

Augusta, Ga.—The city has appropriated $8,000 for a new bridge.—The North Augusta Land Co. has engaged Mr. Grant Wilkins, of Atlanta, to prepare plans and specifications for a bridge over the Savannah River Proposals will soon be called for.

Florence, Ala.—The steel drawbridge of the Memphis & Charleston Ry. will be finished in 2 months.

Wheeling, W. Va.—The contract for a stone bridge at Main St. has been let to Paige, Carey & Co., New York City, for $109,000.—C. E. Stewart & Co., of Lancaster, Pa., are building a double track steel bridge, costing about $100,000, for the Baltimore & Ohio.

Huntington, W. Va.—Ingram & O'Neill have a contract for one 400-ft. span and one 100-ft. span near Barboursville.

Memphis, Tenn.—The piers for the Mississippi River bridge are nearly completed, and erection of the superstructure will soon begin.

Bay City, Mich.—Bids are to be asked for the Belinda St. Bridge. About $80,000 will be the total cost.

Saginaw, Mich.—The Flint & Pere Marquette, Ry. will build a bridge over Washington Ave.

Eau Claire River, Wis.—Schailer & Schniglau, of Chicago, have the contract for a bridge—5 truss spans—on the Wisconsin Central Ry. over the Eau Claire River.

Winona, Minn.—Work is in progress on the foundations for the Mississippi river bridge at this place.

Decatur, Ia.—Surveys have been made by Illinois Central Ry. engineers for a bridge over the Missouri at this point.

Topeka, Kan.—A new bridge over the Kansas River is again being discussed. The cost would be about $200,000.

Tunnels.—***Long Island City, N. Y.***—It is proposed to build tunnels under Newtown Creek to avoid the delay from the drawbridges.

Honesdale, Pa.—It is stated that the New York, Lake Erie & Western will build a tunnel from Forest City to Honesdale, Pa., costing about $2,000,000.

Staten Island and Brooklyn.—Erastus Wiman's scheme for a tunnel under the Narrows is elsewhere noted.

WATER-WORKS.

NEW ENGLAND.

Stockbridge, Mass.—The Water Committee has submitted its report on the question of a better water supply, recommending that Lake Averick be taken as the source of supply, and that the town issue $125,000 of 4% bonds, payable in 30 years, to meet the expense of constructing the works.

Chicopee, Mass.—New mains will probably be laid through Market Square.

North Brookfield, Mass.—A system of water supply is to be established. Francis Batcheller has made a report and submitted plans, recommending that the dam at Doane's Pond be raised to a height of 10 ft., running a dyke around the north end of the pond to catch the swamp water and water from Horse Pond and convey it around to the pumping station, where it can be pumped to a reservoir of 1,000,000 galls. capacity, located on Bell Hill, thence by gravity to the town. Total estimated cost, $57,000.

Springfield, Mass.—William P. Latham has been awarded the contract for building a dam at the Blackmer and Walker saw-mill pond, and George M. Atkins & Co. will build the canal on the southeast shore of the reservoir and do the widening and deepening of the Ax factory and Broad Brook canals. The R. F. Hawkins Iron Works will place a wrought-iron conduit for carrying the water across the Cherry Valley dam. Contractors are figuring

on the rest of the job, but the commissioners will probably lay the pipe to convey the water of Higher Brook into the Ludlow reservoir at a point near the gate-house. The city has considerable pipe on hand which can be utilized, but the hill will be tunneled for 200 ft.

Westminster, Mass.—E. S. Kendall, Town Clerk, has sent us the following:

The question of building works is being agitated, and a committee has been appointed to investigate the matter and report upon it. Chairman, E. L. Burnham.

Great Barrington, Mass.—The court has been asked to appoint a commission to appraise the property of the water companies.

Providence, R. I.—The Board of Aldermen has voted to expend $75,000 for repairing the Fruit Hill reservoir. Also to add $25,000 "to the appropriation for the Providence water-works."

Waterbury, Conn.—The following is taken from the Waterbury *American:*

Waterbury is having a great time with her city water. "Thick as sewer water," is the appetizing description that the *American* gives of the fluid.—*Meriden Republican.* Outside papers will please remember that the "sewer water" includes only a comparatively small section of the city, taking water from the Cook St. reservoir. The great majority receive water directly from the East Mountain reservoirs, than which there is none better in the State. Were they all compelled to swallow Cook St. water for a few days there would be a speedy revolution.

Meriden, Conn.—Investigations are being made for increasing the water supply from Black Pond and other sources. Professors Williston, Brewer and Lindsley are to make investigations and submit a report to the city for the State Board of Health.

MIDDLE.

Amsterdam, N. Y.—The Water Commissioners are considering the matter of tapping the Chuctanunda Creek for an additional water supply.

East Aurora, N. Y.—Engineer White, of Buffalo, N. Y., is making surveys for the new water supply system.

Rochester, N. Y.—The Holly Mfg. Co., Lockport, N. Y. has been awarded the contract for furnishing the pumping engine to be used at the Gates artesian well.

Franklinville, N. Y.—A majority vote favoring the construction of works was taken on July 31. Work is to be commenced at once.

Rochester, N. Y.—The Executive Board has directed Acting Chief Engineer Rafter to at once prepare estimates of the cost of the preliminary operations for laying a new conduit from Hemlock Lake to the city.

Whitestone, L. I., N. Y.—The Board of Trustees is discussing the advisability of putting in a water supply.

Mohawk, N. Y.—Sealed proposals will be received by the Board of Water Commissioners until Aug. 13 for the material and labor required for constructing works. Plans may be seen and specifications and blank proposals obtained at the office of the commissioners.

Keyport, N. J.—We have received the following:

The town has voted to raise $600 for experimenting in sinking a well as a source of supply.

Perth Amboy, N. J.—James Wright, City Clerk, has sent us the following:

Clark Malcom, of Metuchen, N. J., appeared before the City Council on July 21 and stated that they had a number of springs at Metuchen at a sufficient elevation to furnish water by gravity, which could be so connected that a supply sufficient for this city and the surrounding towns could be furnished. He further stated that the Lehigh Valley R. R. Co. would permit them to lay mains along the roadbed of the company. He also left diagrams showing the location of the springs, and statements that their combined flow produced a 45-in. stream.

South Orange, N. J.—A contract has been signed by the town for a water supply for domestic use with the Commonwealth Water Co., of Newark, N. J. Carroll Ph. Bassett and Franklin Murphy are connected with the company, which now has a plant in operation at Summit. The contract calls for a daily supply of 50,000 galls. A stand-pipe will be erected.

Scottdale, Pa.—The difficulties existing between the Town Council and the Citizens' Water Co. have been adjusted by the company agreeing to furnish bonds for $10,000 for three years. Work on the plant is to be commenced at once. The reservoir will be erected at Mount Vernon.

Lebanon, Pa.—Another large dam will probably be constructed at South Mountain to impound water from springs for increasing the water supply.

Greensburg, Pa.—Arrangements are being made to extend the plant and draw water from additional springs.

SOUTHERN.

Wytheville, Va.—It is proposed to bring the water supply from Lick Mountain, 6 miles distant. Address W. L. Yost, Mayor.

New Castle, Va.—The officers of the New Castle Water Co. are: President, A. E. Humphreys; Secretary, P. V. Jones. Work will soon be commenced.

Richland, Va.—The town has signed a contract for the construction of a system of works.

Columbia, S. C.—John Bauskett has submitted the following proposition to the City Council, renewing the offer of the "West System of Filtration" to supply the city with pure water:

To set up a set of filters for furnishing a daily supply of 1,000,000 galls. for $8,000; and for the right to use the franchise, $5,000. The filters to be built directly over the present reservoir, and river water pumped directly into them to pass through and fall into the reservoir perfectly pure and clear. An unlimited supply of river water is now secured.

Aiken, S. C.—Correspondence is solicited with artesian well drillers for sinking a well. The contract will be let soon.

Tallapoosa, Ga.—A. V. Howe, City Clerk, has sent us the following:

The contract for constructing the new works has been awarded to Woltmann, Keith & Co., 11 Wall St., New York. Work was commenced on July 1, and is to be completed by Oct. 15. Engineers in charge, George Keith and E. F. Fuller. Water will be pumped from Damell Brook to a stand-pipe. Estimated cost, $45,000. Population, 3,000.

St. Petersburg, Fla.—Address L. King for information regarding the projected works.

Opelika, Ala.—F. M. Renfro, President First National Bank, has sent us the following information:

The company has not been organized as yet. The city is ready to grant a franchise and make a contract for water. It is proposed to bring the supply from Springville, six miles distant. Estimated cost, $50,000 to $50,000. Population, 4,500.

Fulton, Ky.—The city will issue water bonds for $25,000.

Ludlow, Ky.—The town has made application to obtain its water supply from Covington, Ky. The Water-Works Commissioners, of Covington, have agreed to furnish a supply, the water to be conveyed to Third St. and the conporation line, where a meter will be established, the Ludlow authorities to lay their own pipe and service branches from that point. The citizens of Ludlow want West Covington to join with them in getting water.

NORTH CENTRAL.

Marysville, O.—The following information has been received:

Works are to be constructed by the Marysville Water and Light Co. Estimated cost, $90,000. John W. Hill, Cincinnati, O., is the Engineer in charge. Contracts will be let on Aug. 15. Water will be pumped from driven wells direct to mains. Population, 3,000.

Zanesville, O.—A. W. Harris & Co., of New York, have purchased the $50,000 of 4½ per cent. bonds at a premium of $585.

London, O.—Contractor John P. Martin, Xenia, O., has commenced the construction of the new works.

Muncie, Ind.—H. M. Payson & Co., Portland, Me., are offering $20,000 of 5 and 6% bonds of the Muncie Water Works Co. for sale.

Huntington, Ind.—Allen T. Prentice, of Chicago, Ill. Agent for R. D. Wood & Co., has sent us the following:

All bids for constructing the new works have been rejected, being too high. The estimated cost was $95,000. The lowest bid received was $120,000.

Franklin, Ind.—We have received the following:

A 25 years' franchise for constructing works has been granted to the Franklin Water, Light & Power Co. The Board of Directors for the first year are: M. L. Johnson, W. B. Jennings, B. P. Brown, U. G. Reeve and John J. Hainsworth. The city will pay $3,000 per annum for 60 hydrants.

Grand Rapids, Mich.—The Cook Well Co. has been awarded the contract for sinking wells for the new source of supply.

Ipava, Ill.—Joel C. Kost, Clerk, has sent us the following:

Work has been commenced by George W. Sturtevant, Jr., the contractor and constructing engineer. Designing Engineer, H. A. Cleveland. The works are to be owned by the Ipava Water-Works Co., J. L. McCune, President. Water will be pumped from an artesian well to a stand-pipe. Estimated cost, $10,750.

Springfield, Ill.—Satisfactory progress is being made on the improvements. The excavation for the new tunnel is down to the point where the gallery is to be sunk, and 150 ft. of the gallery is already finished.

Chicago, Ill.—Arrangements have been made with Shailer & Schniglau, the contractors who are constructing the Lake View tunnel, to put in the 5,000 ft. additional which the Council has ordered. They will be paid at the same rate as for the first part of the work, with additional compensation for sinking the crib to the greater depth required by the change in the plans.

Duquoin, Ill.—The City Council has passed an ordinance granting a 25-years' franchise to Truesdale & Foster, of St. Louis, Mo.

Alton, Ill.—The question of extending the mains to the town of Upper Alton and furnishing a water supply is being discussed.

NORTHWESTERN.

Correctionville, Ia.—The Town Council is visiting different places to investigate various systems of water supply.

Superior, Minn.—The large pipes for the intake of the Water, Light, and Power Co., under Minnesota Point to Lake Superior, are being laid by John F. Ward, of Jersey City, N. J. The intake pipe will be about 2,000 ft. long.

Potwin, Kan.—The Potwin Water Supply Co. has been chartered. The directors are: C. P. Baker, D. C. Tillotson, J. R. Moore, F. B. Johnson and W. P. Tomlinson. Capital stock, $60,000. The Town Council has received a proposition from this company to put in works. Also one from the Topeka Water Supply Co.

Hiawatha, Kan.—C. H. Lawrence has sent us the following:

The works are to be built, owned and maintained by the city. Work has been commenced and is to be completed in 60 days. Water will probably be pumped from wells to a reservoir. Estimated cost, $10,000. Engineer, W. Kiersted, Kansas City, Mo. Mayor, J. B. Bause. Population, 2,500.

Sutton, Neb.—The City Council has contracted with Engineer A. A. Richardson, Lincoln, Neb., to prepare plans for a $20,000 system of works. Bonds were voted two years ago to build the works, but the State Auditor refused to register them on a technicality which was sustained by the supreme court. The citizens expect that bonds will be carried almost unanimously.

York, Neb.—The Board of Health has passed resolutions condemning the water furnished by the company as unhealthy and unfit for use. The company has been pumping water from a creek.

Humboldt, Neb.—The proposition to bond the city for establishing works has been defeated by a citizens' vote.

Crawford, Neb.—The Town Trustees have called a special election to vote $17,000 of bonds for a system of works.

Vermillion, S. Dak.—An effort is being made to organize a water company to put in works.

Fargo, N. Dak.—An ordinance has been passed adopting the proposition of the Water and Steam Co. for the sale of its works. It was moved that the bids on engines, hydrants, valves, pumps, etc., be rejected, and that the checks accompanying them, and Mr. Porrett's check, be returned, with the understanding that the latter's bid for the extension of the water mains be held for further action.

SOUTHWESTERN.

Lebanon, Mo.—W. K. Allen, of Clinton, Mo., has submitted a proposition for establishing works, which will probably be accepted.

Kansas City, Mo.—The special committee has adopted the amendment to the charter empowering the city to buy, build or lease works. The special election to decide what action will be taken will be held on Sept. 16.

Mammoth City, Ark.—The following information is from Robert Greer:

The question of water supply is still in an embryotic state. The Mound City Water, Light & Motor Co. has been incorporated. President, Robert Greer; Secretary, E. F. Brock. It is proposed to pump water from Mammoth Springs at the head of Spring River to a reservoir. Population, 1,000. Hydrants will be used.

Helena, Ark.—A good flow of water has been obtained in the artesian well at a depth of 400 ft.

Morrillton, Ark.—A 25 years' franchise has been granted to W. J. Stowers, M. D Shelby, E. B. Henry and W. B. De Long for constructing works. They are to be completed in 18 months.

Gatesville, Tex.—The new works will be constructed by the Gatesville Water Supply Co. President, N. M. Duffie; Secretary, J. W. Sanders. The supply will be taken from artesian wells.

Ballinger, Tex.—Address B. S. Taylor, Mayor, for information regarding the projected works.

Sherman, Tex.—It is reported that about $20,000 is to be expended for securing a water supply from an artesian well.

Boulder, Col.—New bids are wanted by Alderman Temple for constructing the mountain system. The contract for excavating the reservoir and building the dam was let to W. R. Terry at $5,890. This is the reservoir in Sunshine cañon. The reservoir will hold 5,000,000 galls. of water.

Grand Junction, Col.—A company is being organized to sink a well.

Pueblo, Col.—The Pueblo Water Co. has been incorporated by Hugh J. Fitch, James A. Jay and Frank M. Dunbaugh. The company will at once begin the construction of reservoirs on the south bank of the Arkansas River, near Bessemer, in Pueblo Co., and from them will furnish the city with water. The capital stock is $300,000.

PACIFIC.

Port Angeles, Wash.—Benezette Williams, of Chicago, Ill., has been retained by the water company as Consulting Engineer. He is now at work on the plans for new works.

Dayton, Wash.—We have received the following from F. S. Miller:

Contracts will be let about Oct. 1 for works to cost about $55,000. Bonds for this amount will be issued and sold by the city. The supply will be taken from Touchet River. For further information address J. H. Day. Population, 2,000.

Oregon City, Ore.—Mayor Thomas F. Ryan has kindly sent us the following:

The election on July 28 to levy a three mill tax was carried. The City Council has ordered that bids, plans and specifications for a 1,000,000 gall. pump be advertised for and received until Sept. 1. A new water-wheel will also be purchased.

San Diego, Cal.—City Clerk W. M. Gassaway has sent us the following information:

The City Council has passed an ordinance to provide an adequate and complete system of works. An election will probably be held about Sept. 1 to vote on the question of issuing $320,000 of bonds.

Vacaville, Cal.—The new works have been completed and satisfactorily tested.

CANADA.

Owen Sound, Ont.—Sealed tenders will be received by the Water-Works Committee until Aug. 15 for laying about 5 miles of 10, 8 and 6 in. water pipe, according to plans and specifications to be seen at the office of Town Engineer J. C. Kennedy. John Armstrong is Chairman of the Water-Works Committee.

ARTESIAN WELLS.

Rock Hill, S. C.—E. Fewell proposes to sink a well.

Belton, Tex.—A company has been organized to bore a well to supply the city. Work will be begun at once.

Hempstead, Tex.—Bids for sinking a well in Market Square are wanted by the Hempstead Progressive Association.

McGregor, Tex.—It is reported that a stock company has been organized to sink a well.

Greenville, Tex.—A well will probably be sunk.

Heppner, Ore.—A vote will be taken on the question of issuing $5,000 of bonds for sinking the well deeper.

Morden, Manitoba—The well has been abandoned at a depth of 600 ft. It is possible that another well will be sunk in another locality.

IRRIGATION.

Anaheim, Cal.—The Anaheim Water Co. has agreed to sell its property and franchise to the Anaheim Irrigation District for $130,000.

Payette, Idaho.—At a meeting of the stockholders of the Payette River Canal and Land Improvement Co. a committee was appointed to make a report upon the lands and line of the proposed canal to take water out of Payette River, near Emmett, and cover some 30,000 or 40,000 acres of land. Work will probably be commenced soon.

Eagle Rock, Idaho.—The Idaho Falls Canal and Irrigation Co. has been incorporated, with a capital of $3,000,000. They will commence operations at once, and intend expending about $500,000 during the present season.

Tolo, Ore.—A survey has been commenced for an irrigating ditch from Rogue River, to be taken out at the Pickens bridge in the vicinity of Tolo, Jackson Co. It is proposed to build a ditch 4 ft. square, and will probably be about 4 miles long.

Silver City, Idaho.—The River Canal Co. will soon commence the construction of a dam across the Bruneau River, on or near the site of the old dam.

Yankton, S. Dak.—The Artesian Power Co. has been incorporated with a capital stock of $100,000. The object of the company is to develop the artesian water power in Yankton and vicinity.

Pasco, Wash.—Sealed proposals will be received until Sept. 2 for $100,000 of Pasco Irrigation District bonds, by R. Olney, Secretary.

SEWERAGE AND MUNICIPAL.

Paving has been ordered at Brookline, Mass.; Providence, R. I.; Brooklyn and New York, N. Y.; Newark, N. J.; Wilkinsburg, Pa; Washington, D. C.; New Orleans, La., brick; Knoxville, Tenn.; West Duluth, Minn., estimated cost, $30,000; Pierre, N. Dak.

Buffalo, N. Y.—Assessment rolls amounting to $310,000 for paving, chiefly with asphalt, have been prepared.

Duluth, Minn.—Cedar block pavement costing $88,280 has been ordered, as well as some macadamizing.

St. Paul, Minn.—Streets have been ordered opened and widened at an estimated cost of $86,700; also cedar block paving costing $12,410.

Salt Lake City, Utah.—Plans for $90,000 of brick, asphalt and granite pavement.

Sewers.—*Ordered* at Montreal, P. Q.; Boston, Mass.; Providence, R. I.; Rochester, Brooklyn and New York, N. Y.; Meridian, Miss.; Columbus and Cincinnati, O.; Detroit, Mich.; St. Paul, Minn.; Alameda, Cal.

West Toronto, Ont.—Plans for a system of sewerage in which sanitary sewers will empty into Lake Ontario and the Humber River while the surface sewers will empty into neighboring ravines, have been prepared by W. Chipman. The work, if carried out, will cost $255,000.

Buffalo, N. Y.—Assessment rolls for 7½, 7, 6¾, 6½, 6¼, 6, 5½, and 5 ft. brick sewers, costing $136,000, have been prepared.

Nashville, Tenn.—A trunk sewer costing $75,000 will be built.

Columbus, O.—The Board of Public Works contemplates constructing a double system of sewers.

Bonds.—*Winston, N. C.*, will issue $200,000 of improvement bonds, the money to be used for the construction of water-works, sewers and paved streets.

ELECTRICAL.

Electric Light.—*New Plants* will be built at Greensboro, N. C., address J. A. Odell; Marion, N. C.; Chester, S. C.; Greensboro, Ala.; Dawson, La.; Humboldt, Tenn.; Mt. Sterling and Earlington, Ky.; Santa Fe, N. Mex.

Templeton, Tex.—A 500 incandescent lamp plant is wanted.

Piedmont, Cal.—The Piedmont Cable Co. has received permission to light its lines by electricity; the car house and engine houses will also be so lighted.

Los Angeles, Cal.—The city contemplates building a light and power station to be operated by water power.

Seattle, Wash.—The General Electric Co. will enlarge its plant so as to furnish power as well as light.

New Companies.—The Traylor Electrical Co., Richmond, Va.; incorporators A. W. Garber, T. Potts, J. E. McKinney; capital stock, $100,000; object, manufacture of motors and light plants. Augusta, Ga., Electric Light & Motor Co.; incorporators, D. B. Dyer, R. M. Spivey, R. M. Conklin; object, furnishing light and power in the city and suburbs. Brown Electric Co., Chicago, Ill.; incorporators, F. H. Brown, I. L. Moore and others; object, dealing in patents; Dyer Electric Co., Chicago, Ill., incorporators, I. T. Dyer, H. S. Dickson, G. W. Huddleston; capital stock, $10,000,000; object, manufacture and sale of Dyer electric patents. Mosher Arc Lamp Co., Abilene, Kan.; incorporators, J. A. Mosher, W. S. Hodge and others; capital stock, $50,000.

CONTRACTING.

Paving.—*Columbus, O.*—The Ohio Paving Co. has an $80,000 contract for laying Hallwood blocks.

Paving Blocks.—*Montreal, P. Q.*—3-in. tamarac blocks have been offered at $20 to $28 per M.

Brick Paving.—*Washington, Pa.*—Recent bids ranged from 30 to 56 cts. per cu. yd. for excavation, $1.13 to $1.61 per sq. yd. brick paving and 39 to 68 cts. per sq. yd. for gravel or broken stone foundations. The contract was awarded at 45 cts. per cu. yd. for excavation and $1.53 per sq. yd. for paving.

Filling.—*Flushing, N. Y.*—Prices ranged from 21½ to 47c. per cu. yd. on recent bids.

Street Improvement.—*New York City.*—A contract for improving 155th st., at an estimated cost of $514,400, has been granted to H. Steward.

Dredging.—*New York City.*—A recent contract was awarded at 20 cts. per cu. yd.

Levee Work.—*St. James, La.*—200,000 cu. yds.; 2 bids at 30 and 1 at 39.99 cts. per cu. yd.

Pointe Coupee, La.—126,000 cu. yds.; bids per cu. yd ranged from 16 to 22⅞ cts.

Plaquemines, La.—70,000 cu. yds. Bids were 16.9 and 24 cts. per cu. yd.

Stone Culvert.—*Baltimore, Md.*—Prices for excavation ranged from 25 to 65c. per cu. yd.; stone paving, $4 to $6.50 per cu. yd.; rubble masonry, $4.25 to $6.50 per cu. yd.; sheeting, $5 to $6.75 per cu. yd.; coping, 50 to 95 cts. per sq. ft.; lumber, $25 to $50 per M. ft.

PROPOSALS OPEN.

Paving.—*West Chester, N. Y.*—Grading, draining and paving. J. C. Cooley. Aug. 13.

Brooklyn, N. Y.—Cobblestone. J. J. Adams. Aug. 12.

York, Pa.—2,000 cu. yds. excavation and 5,500 sq. yds. vitrified brick. W. H. Rodenhouse. Aug. 19.

Baltimore, Md.—Sheet granolythic. A. E. Smyrk. Aug. 12.

Washington, D. C.—Granite block pavement and granite curbing. J. W. Douglass. Aug. 30.

Cleveland, O.—Grading, draining, curbing, paving with Medina sandstone and filling joints with concrete. C. G. Force. Aug. 21.

Columbus, O.—Asphalt, stone block, Hayden or Hallwood block, fire-clay or hard-burned Hayden or Hallwood block or brick pavement, and 5-in. Berea or Fulton curb.

St. Paul, Minn.—Cedar blocks on plank foundation, together with granite curbing and sewer connections. R. L. Gorman. Aug. 14.

Sidewalks.—*Montreal, P. Q.*—Rock asphalt, mastic, cement and blue flagstone. P. W. St. George. Aug. 13.

Brooklyn, N. Y.—Flagstone. J. J. Adams. Aug. 11.

New York City.—Flagstone. T. F. Gilroy. Aug. 12.

Kingston, N. Y.—Six miles. City Engineer. Aug. 18.

Sewers.—*Flatbush, N. Y.*—H. Hesterberg. Aug. 11.

Buffalo, N. Y.—3½, 3, 2⅝, 2½, 2¼ and 2-ft. brick and smaller pipe sewers. City Engineer.

Washington, Pa.—Proposal for 1 mile of main and 3,500 ft. of lateral sewers will be wanted shortly. Wilson & Smith have charge of the work.

Greensboro, N. C.—Pipe. W. R. Houston. Aug. 21.

Cleveland, O.—C. G. Force. Aug. 14 and 28.

Louisville, Ky.—Steel or wrought iron sewer, 500 ft. long, including excavation, pile driving, masonry and metal work. W. L. Lyons. Aug. 12.

St Paul, Minn.—J. C. Quinby. Aug. 11.

Grading.—*Brooklyn, N. Y.*—J. J. Adams. Aug. 13.

New York City.—T. F. Gilroy. Aug. 12.

St. Paul, Minn.—J. C. Quinby. Aug. 11.

South Omaha, Neb.—E. Conley. Aug. 11.

Brick.—*Boston, Mass.*—About 2,000,000 hard-burned brick for sewers. Metropolitan Sewer Commission, Sept. 1.

Pipe.—*Carthage, O.*—Cast-iron. H. Simms, Aug. 12.

Seattle, Wash. Cast-iron; 8,000 ft. 30-in., 5,000 ft. 24-in., 13,800 ft. 20-in., 2,700 ft. 16-in., 5,900 ft. 12-in., 9,700 ft. 10-in., 24,000 ft. 8-in., 60,000 ft. 6-in. Wrought iron; 12,000 ft. 12-in., 6,600 ft. 8-in., 4,000 ft. 6-in.; 300 fire hydrants, 170 tons of special castings.

Timber.—*Buffalo, N. Y.*—35 M. white oak, 288 M white pine, 461 M. hemlock and 77 M. surface pine planks. E. Hannan, Albany. Aug. 11.

Pier Work.—*Ottawa River near Ste. Anne.*—Lockmaster, Ste. Anne, P. Q. Aug. 30.

Court-house.—*Spartanburg City, S. C.*—C. A. Barry Aug. 30.

Hospital.—*Washington Barracks, D. C.*—Lieut. C. Chase, Aug. 30.

Boiler and Engine. *Chattanooga, Tenn.* Two 75 H P. engines and two 100 H P. tubular boilers. S. Newton, Xenia, O.

Dredging.—*Kanakee River near Momence, Ill.*—Limestone ledge. B. Carr, Indianapolis, Ind. Sept. 1.

Locomotive.—*Ellisville Depot, Miss.*—For tramway, Hough & Bennett.

Bridges.—*Whitby, Ont.*—Two bridges of 75 and 65 ft. span, with 16 ft. roadway; may be built of iron, wood, or iron and wood. T. E. Farewell, Aug. 14.

Water-Works Pump.—*Oregon City, Ore.*—Must have 1,000,000 galls. daily capacity. J. W. O'Connell, Sept. 1.

Dam.—*New York, N. Y.*—Building an earth and masonry dam, with gate-house, for Reservoir D., on a branch of the Croton River, near Carmel, N. Y. J. C. Duane, President, Aug. 27.

Electric Lighting Plant.—For U. S. S. Lancaster, George Dewey, Chief of Bureau of Equipment, Portsmouth, N. H., Aug. 22.

MANUFACTURING AND TECHNICAL.

National Meter Co.—The 12th annual dinner of the above Company to its employés was given at Rockaway Beach, on the 2d inst. 136 out of the 175 employés in the service of the Company were present.

Car Works.—The Great Northern Ry. shops will be located at St. Cloud, Minn. Five buildings will be built.

Locomotives.—The Baldwin Locomotive Works are building 10 freight engines for the Mexican Central Ry., 12 for the Interoceanic Ry., and 12 for the Mexican Central Ry. A recent order for 8 engines came from Japan. The Philadelphia & Reading R. R. recently received 10 fast passenger locomotives from the Baldwin Works. The Nashville, Chattanooga & St. Louis Ry. has given an order for 20 freight engines to the Rogers Works. The Kingston Locomotive Works have recently sold five engines to the Canadian Pacific Ry., one to the Northern Pacific & Manitoba Ry., and one to the Quebec & Central Ry.

The Keystone Bridge Co. have the contract for the iron work on the inclined railway at Duluth, Minn.; estimated cost, $110,000.

The Columbia Bridge Works, Dayton, O., have been bought at sheriff's sale for $38,000 by Carnegie, Phipps & Co.

The Variety Iron Works, Cleveland, O., are furnishing the iron work for two new buildings for the Walker Mfg. Co., of Cleveland, O. One foundry 118 × 291 ft. will be fitted for 10 and 25 ton traveling cranes, and a machine shop 172 × 412 ft. will be fitted for 25 ton traveling cranes. Cranes in either building will run the whole length.

The Industrial Works, of Bay City, Mich., have recently received the following orders: A heavy steel jib crane for the new shops of the Nashville, Chattanooga & St. Louis Ry. at Nashville, Tenn., a standard pile driver for the Milwaukee, Lake Shore & Western Ry. 2 70-ft. steel transfer tables for the Hudson shops of the Chicago, St. Paul, Minneapolis & Omaha Ry. and 2 similar tables for the new car and machine shops of the Northern Pacific R. R. at Tacoma, Washington. One of the last will be 70 ft., the other 40 ft. long, and each will be of the largest capacity, constructed for the heaviest service, and operated by electricity.

New Companies.—Foster Engineering Co., East Orange, N. J.; incorporators, H. McConnell, East Orange; J. M. Foster, Cranford, and H. Canfield, Morristown; capital stock, $40,000. Calvert Building & Construction Co., Baltimore, Md.; incorporators, J. A. Gary, E. F. Abell, F. C. Latrobe, and others; capital, $1,000,000; object to build a "rookery" similar to that at Chicago. Hooker Steam Pump Co., Chicago, Ill.; incorporators, W. D. Hooker, W. Vait, H. C. Tulley; capital stock, $21,000. Low Adjustable Car Co., San Francisco, Cal.; incorporators, J. B. Low, A. K. Grimm, J. H. Boalt; capital stock, $1,000,000.

Metal Market Prices.—*Rails*—New York: $31 to $31.50 for old iron rails, $24 to $24.50; Chicago: $35.50; old rails $26 to $26.50 for iron, $19.50 to $22 for steel. Pittsburg: $31.50 to $32 old rails, $27 to $27.25 for iron; $21.50 to $22.50 for steel.

Foundry Pig-iron.—Chicago: $15 to $17.50. Pittsburg: $15.75 to $17.50. New York: $16 to $18.

Track Materials.—New York: steel angle bars, 1.75 to 1.9 cts.; spikes, $2 to $2.10; track bolts, 2.8 to 3 cts. with square, and 3.10 to 3.15 cts. with hexagon nuts. Pittsburg: splice bars, 1.9 to 2 cts. for iron; spikes, 2.01 to 2.15 cts.; track bolts, 2.85 with square, and 3 cts. with hexagon nuts. Chicago: splice bars, 2.25 cts. for steel, and 2.05 to 2.1 cts. for iron; spikes, 2.15 to 2.2 cts; track bolts, 3.2 to 3.25 cts. with hexagon nuts.

Pipe.—Cast-iron, $27 to $30 per ton. Wrought iron, discounts as follows: 47½ and 40 per cent. on black and galvanized butt-welded; 60 and 47½ on black and galvanized lap-welded. Casing, 50 per cent.

Lead.—New York, 4.35 cts.; Chicago, 4.3 to 4.35 cts.

Structural Material.—Pittsburg: angles, 2.2 to 2.25 cts.; tees, 2.8 cts.; beams and channels, 3.15 cts.; sheared steel bridge plates, 2.7 cts.; universal mill plates, 2.55 cts.; refined bars, 1.90 to 2 cts.; steel plates, 4.3 to 4.8 cts. for fire box; 3.2 to 3.25 cts. for flange; 3.05 cts. for shell, 2.75 to 2.8 cts. for tank. New York: beams, 3.10 cts.; plates, 2.15 to 2.20 cts.; angles, 2.25 cts.; tees, 2.5 to 2.6 cts.; channels, 3.1 cts. Chicago: angle, 2.3 cts.; tees, 2.8 to 2.9 cts.; beams, 3.2 cts.; universal plates, 2.45 to 2.55 cts.

Commonwealth of Massachusetts.

Metropolitan Sewerage Commissioners.

NOTICE TO CONTRACTORS.

Sealed bids for building sections 8 and 9 of the Metropolitan Sewerage System (East Boston) and sections C and D (Brighton), all in the city of Boston, in accordance with the form of contract and specifications to be furnished by the Board of Metropolitan Sewerage Commissioners, will be received by said Board at its office, 93 Lincoln street, Boston, Mass., until 12 o'clock M. of Wednesday, Aug. 13, 1890.

No bid will be received unless accompanied by a certified check for the sum of one thousand dollars.

All bids must be made upon the blank forms furnished by the Board.

The external diameter of the sewer on sections 8 and 9 is from eleven to fifteen feet, and on sections C and D is from six and one half to nine feet. Some other particulars are approximately as follows:

Sec.	Length. Feet.	Av. depth. Feet.	Cub. yds. brick masonry.	Cub. yds. concrete masonry.	No. piles.
8.....	4,100	15	1,800	4,900	40
9.....	3,700	14	2,000	4,000	40
C....	5,800	15	1,500	2,600	1,000
D....	5,400	16.5	1,000	2,400	100

Plans can be seen and specifications and form of contract can be obtained at the above office.

Each bidder is required to make a statement indicating what sewer and similar work he has done, and to give references that will enable the Board to judge of his business standing.

The Board reserves the right to reject any and all bids.

HOSEA KINGMAN, TILLY HAYNES, ROBERT T. DAVIS, } Board of Metropolitan Sewerage Commissioners of Massachusetts.

HOWARD A. CARSON, Chief Engineer.

29 4t

Vertiucal Pmps.

CINCINNATI, O., July 31, 1890.

Sealed proposals will be received at the office of the Board of Public Improvements until 12 o'clock noon, Aug. 23, 1890. For four vertical pumps of five million capacity each in twenty-four hours. These pumps to take the place of similar size Wetherell pumps now in position, and to be operated by the steam ends now in use. Each bidder is requested to examine and measure the pump well, and so design his work as to properly connect with the parts to be retained. Each bidder will furnish his own plans, drawings and specification, with guarantee as to date of completion, and forfeiture for failure in duty.

For further particulars apply to Willis P. Tharp, Superintendent and Engineer in charge of City Water-Works.

The Board of Public Improvement reserves the right to reject any or all bids.

By order of the Board of Public Improvements. LOUIS REEMELIN, President.
Attest: A. P. BUTTERFIELD, Clerk B. P. I.

32-2t

To Civil Engineers.

The Council of the City of Vancouver having decided to secure the services of an Engineer-in-Chief to take charge of the sanitary and general engineering of the city, applications for such position are solicited.

Applicants to furnish references and testimonials of fitness for the office, and state salary required.

Applications will be received up to 15th September, 1890, and any required information will be furnished by

THOMAS F. McGUIGAN,
Vancouver, July 18th, 1890. City Clerk.

Notice to Contractors.

Sealed proposals will be received by the "Citizen's Heat, Light and Power Co., of Blairsville," for the construction of a plant for furnishing heat, light and power by electricity to those who may require the same, in Blairsville and vicinity. Plans and specifications can be procured on application to D. A. Fenlon, Secretary, or Antes Snyder, President of said company, Blairsville, Indiana Co., Pa. Bids should be deposited with the Secretary by noon of the 15th day of August, 1890, and be marked "Bids on the Plant of the Citizen's Heat, Light and Power Co."

D. A. FENLON, Secretary.
31-2t BLAIRSVILLE, Indiana Co., Pa.

S. E. NOBLE, Prest. JNO. E. WARE, Secy. and Treas. R. F. CARTER, Supt.

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MANUFACTURERS OF

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DOUBLE STRENGTH
SEWER & CULVERT PIPE.

MONMOUTH MINING & MFG. CO., MONMOUTH, ILL.

Pumping Engines.

CINCINNATI, O., July 31, 1890.

Sealed proposals will be received at the office of the Board of Public Improvements until 12 o'clock noon, Aug. 23, 1890, for two Compound Duplex Pumps—capacity six millions each in twenty-four hours—each bidder to furnish his own plans, drawings and specification; also, guarantee as to time of delivery and forfeiture for failure in duty. Working pressure to be one hundred pounds and steam pressure to be one hundred and fifteen pounds. Engines to be used non-condensing, but so arranged as to work condensing in the future.

For further particulars apply to Willis P. Tharp, Superintendent and Engineer in charge of the City Water-Works.

The Board reserves the right to reject any or all bids.

By order of the Board of Public Improvements.

LOUIS REEMELIN, President.
Attest: A. P. BUTTERFIELD, Clerk. 32-2t

Iron or Steel Bridge.

Proposals for the erection of an Iron or Steel Bridge of about 30 ft. span will be received by the Trustees of Newport Water-Works until 7:30 P. M., Aug. 22. Specifications and information can be obtained from the undersigned.

Right to reject any or all bids reserved.

CHAS. L. JUNGERMAN,
Civil Engr. and Supt. Water-Works,
32-2t Newport, Ky.

Notice to Contractors.

OFFICE OF BOARD OF WATER COMMISSIONERS, 64 MAIN STREET, TARRYTOWN, N. Y., July 25, 1890.

Sealed proposals will be received at this office until Saturday, Aug. 16, at 12 o'clock noon, for the construction of two wells near the present Village Water-Works, one about 40 ft. in diameter and from 30 to 50 ft. deep; the other about 6 ft. in diameter and from 16 to 20 ft. deep.

Also for the construction of a tool house and shed for storing material. Bids will be received for the wells separately from the tool house and shed. Bids must be indorsed, "Bids for constructing wells," or "Bids for constructing tool house and shed," as the case may be.

Plans and specifications can be seen and all desired information pertaining thereto obtained at the office of the Board of Water Commissioners on and after Aug. 1, 1890.

The right is hereby reserved to reject any or all bids.

Bonds satisfactory to the Board for one half the contract price, with two or more sureties, will be required of those to whom the contract may be awarded.

Cash or a certified check made payable to the Board of Water Commissioners to the amount of $250 must accompany each bid as a guarantee that the party to whom the contract is awarded will within five days after notification of award execute said contract.

ALEX. MEGINLEY,
32-1t. *Supt.*

Marysville, Ohio, Water-Works.

Sealed proposals will be received until noon of Friday, Aug. 15, 1890, by the Light and Water Co. of Marysville, O., for the following items for the Marysville Water-Works:

Six hundred (600) tons of cast iron water pipe, ranging from four (4) to twelve (12) inches diameter; thirty-two thousand (32,000) pounds of special castings; seventy-two (72) four (4) inch double nozzle fire hydrants; fifty-seven (57) stop valves from four (4) to twelve (12 inches diameter.

Fifty-seven (57) stop-boxes for above valves.

Laying of above pipe, setting of above special castings, fire hydrants, stop valves and stop boxes.

One brick pumping station.

One masonry dam.

Two (2) duplex compound direct acting pumping engines, each of seven hundred and fifty thousand (750,000) gallons daily capacity, together with two (2) return tubular boilers, sheet iron chimney, and all appurtenances necessary to complete said machinery.

Proposals must be made on the blank forms furnished by the Light and Water Co., and all legal formalities must be complied with to secure consideration of the proposals.

Plans for above work may be examined and blank forms of proposal and specifications can be obtained at the office of the Light and Water Co., Marysville, O., or the office of the Consulting Engineer, rooms 21-22 Glenn Building, Cincinnati, O.

The proposals must be sealed and addressed to the Light and Water Co., Marysville, O., and be endorsed with the name of the person, firm or corporation which makes the tender, and be accompanied by a certified check payable to the order of the Treasurer of the Light and Water Co., as follows:

Water pipe and special castings	$300
Fire hydrants	$200
Stop valves	$150
Pipe laying	$200
Pumping station	$200
Pumping machinery	$300
Masonry dam	$150

The company reserves the right to reject any and all proposals.

THE LIGHT AND WATER CO.
JOHN F. ZWERNER, President.
JOHN W. HILL, Consulting Engineer, Cincinnati, O.
MARYSVILLE, O., July 28, 1890. 31-2t

New Court House.

Notice to Contractors.

Sealed proposals will be received by the Commissioners appointed for the purpose by the County Court of Monongalia county, West Virginia, at the office of the Clerk of the Circuit Court, in Morgantown, in said county, until 12 o'clock, noon, on Monday, September 1, 1890, for the labor and material and the construction and completion of a Court House at Morgantown, West Virginia, in accordance with the drawings and specifications furnished by John C. Fulton, Architect, copies of which may be seen at this office.

1st. All bids must be made upon the printed forms to be obtained from this office, in a sealed envelope, directed to the undersigned, and marked "Proposals for Court House at Morgantown, W. Va."

2d. As an evidence of good faith every proposal shall be accompanied by cash or certified check to the amount of three hundred dollars ($300), made payable to the County Court of Monongalia county, in case the successful bidder shall fail, for ten days after an award, to execute the required contract and bond for the faithful performance of the terms of the contract. The checks of unsuccessful bidders will be returned to them immediately after the contract is awarded or all bids rejected.

3d. The right is reserved to reject any and all bids.

4th. Bidders are requested to be present at the opening of proposals.

Morgantown, on the Monongahela River may be reached by B. & O. R. R., or from Pittsburg by daily line of steamboats.

R. E. FAST,
32-3t. Secretary of Commissioners.

Street Paving.

Sealed proposals will be received for furnishing the material and laying about 4,750 sq. yds. of granite block paving at the office of the Board of Road Commissioners, City Hall, City of Waterbury, Conn., until 2 P. M., Aug. 20, at which time and place they will be publicly opened and read. All bids must be upon proper blanks, and must be accompanied by a bond for $300 with satisfactory sureties conditioned for the execution of the contract within five days after notice of its award.

A certified check for $300 payable to the City of Waterbury to be deposited with the Board of Road Commissioners will be received in place of the above bond. Specifications can be seen at the City Engineer's office, at which place blank forms of proposal can be obtained as well as further information.

By order of Board of Road Commissioners,
F. W. WHITLOCK,
33-1t Acting City Engineer.

NEW ERA GRADER, DITCHER AND RAILROAD BUILDER.

Excavates canals at a cost of 2 cents per cubic yard, moving ***1,000 to 1,500 cubic yards in 10 hours with six teams and three men.*** Will make a canal 80 feet wide and 8 feet deep. Builds, removes and cuts down hills by loading 600 to 800 wagons of 1¼ yards each in 10 hours at 2½ cents each. Builds railroad embankments or country turnpikes for one-quarter the cost of any other appliance. We also make the Austin-Reversible Road Machine, Buck Scrapers, Wheel and Drag Scrapers, Contractors' Plows, and Street Sweepers. Send for catalogue.

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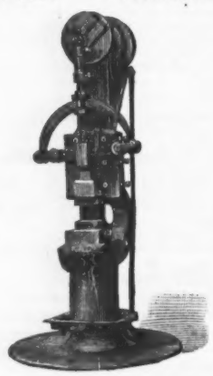

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WANTED.

To know the present address of Mr. Francis F. Hopp, a civil engineer, and within a year a resident of Birmingham, Ala.

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28-8t Boston, Mass.

Two Dredges for Sale.

We have for sale one one and one half (1½) yard Dipper Bucyrus Dredge, and one one and one-half (1½) yard Dipper Marion Dredge. Both are in good condition; can be seen for a few weeks near Jolley, Calhoun County, Iowa. One Dredge can be seen running for the next three weeks. Address

WHEELER & PURSELL,
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JULY 19, 1890. 30 4t.

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Wooden Bridges in America.
Iron Bridges in America.
Combination Bridges.
Designing and Proportioning.
Strength of Material and Parts of Skeleton Structures.
Manufacture of Bridges.
Erecting Bridges.
Typical American Railroad Bridges and their Relative Merits.
Amount and Kind of Bridges on the Railroads of the United States.
Appendix.
List of Folding Plates.

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Highway Bridge over Delaware River at Easton, Pa.
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Trenton Bridge.
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WANTED.—Good field topographer. Must be familiar in taking contours in a mountain country. State experience and salary expected. Address CHIEF ENGINEER, M. & C. G. R. R., Morristown, Tenn. 31-2t

WANTED.—Information of Henry Meyers, Civil Engineer, formerly engaged in Iowa on railroad construction. Address R. P. McCORMICK, Civil Engineer and Contractor for Mississippi River Tunnel and Tower, 904 Olive street, St. Louis, Mo. 31-2t

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All the earthwork, clearing, grubbing, timber work and ties for 35¼ miles on the Iron Range & Huron Bay R. R., between Huron Bay and Champion, in Baraga and Marquette counties, Michigan, will be let in whole or in sections.

Profiles and specifications can be seen at No. 55 Fort street, West Detroit, Mich., where bids will be received until 12 o'clock M., Aug. 14, 1890.

The right to reject any or all bids is reserved.

MILO H. DAVIS,
31-2t Chief Engineer.

Railroad Shops.

BALTIMORE & OHIO RAILROAD COMPANY,
OFFICE OF CHIEF ENGINEER,
BALTIMORE, Md., July 26, 1890.

Proposals will be received at this office until noon on Aug. 12, 1890, for furnishing materials and constructing, in accordance with Plans and Specifications, Roundhouses and Shops at Trinidad, on the Washington Branch, and Brunswick, on the Main Stem of the Baltimore & Ohio R. R.

Plans and Specifications may be seen at this office.

The right is reserved to reject any or all proposals.

H. T. DOUGLAS,
31-2t Chief Engineer.

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50 Cts. 50 Cts

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